ASTRO®

XTS™ 4000 PORTABLE RADIO BASIC SERVICE MANUAL

MOTOROLA

ASTRO® XTS® 4000

Digital Portable Radios

Basic Service Manual

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6871619L01-E

Foreword

This manual covers all models of the ASTRO® XTS® 4000 digital portable radio, unless otherwise specified. It includes all the information necessary to maintain peak product performance and maximum working time, using levels 1 and 2 maintenance procedures. This level of service goes down to the board replacement level and is typical of some local service centers, self-maintained customers, and distributors.

For details on radio operation or component-level troubleshooting, refer to the applicable manuals available separately. A list of related publications is provided in the section, " Related Publications" on page ix.

Product Safety and RF Exposure Compliance

Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6881095C98) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: http://www.motorolasolutions.com/governmentandenterprise

Manual Revisions

Changes which occur after this manual is printed are described in PMRs (Publication Manual Revisions). These PMRs provide complete replacement pages for all added, changed, and deleted items. To obtain PMRs, contact the nearest Radio Products and Solutions Organization (refer to "Appendix B Replacement Parts Ordering").

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Document History

The following major changes have been implemented in this manual since the previous edition:

Edition	Description	Date
6871619L01-A	Initial edition	Mar. 2007
6871619L01-B	Added UHF band	Jan. 2008
6871619L01-C	Added PMNN4083 1260 mAh Li-Ion Battery. Modified Specifications and Accessories info.	Sep. 2008
6871619L01-D	Added in Antenna NAE6553_ (85012029001) 380 – 470 MHz to Table 10.2, 10.3, 10.4 & Appendix A.1	Oct. 2010
6871619L01-E	Update Motorola Solutions Info and rectify pdf orientation issues from previous revision	Dec. 2011

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Related Publications

XTS 4000 Digital Portable Radio User Guide ... 6871618L01
XTS 4000 Digital Portable Radios Detailed Service Manual ... 6871620L01
XTS 4000 Digital Portable Radio User Guide (CD) ... PMLN5057_
Chassis Eliminator Leaflet ... 6871568M01

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Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

I. What This Warranty Covers And For How Long

MOTOROLA SOLUTIONS INC. (“MOTOROLA”) warrants the MOTOROLA manufactured Communication Products listed below (“Product”) against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

ASTRO XTS 4000 Digital Portable Units	One (1) Year
Product Accessories	One (1) Year

Motorola, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of MOTOROLA.

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This warranty gives specific legal rights, and there may be other rights which may vary from state to state.

IV. How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation and insurance prepaid, to an authorized warranty service location. Warranty service will be provided by Motorola through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service. You can also call Motorola at 1-888-567-7347 US/Canada.

V. What This Warranty Does Not Cover

A. Defects or damage resulting from use of the Product in other than its normal and customary manner.

B. Defects or damage from misuse, accident, water, or neglect.

C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.

D. Breakage or damage to antennas unless caused directly by defects in material workmanship.

E. A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola supplied equipment) which adversely affect performance of the Product or interfere with Motorola's normal warranty inspection and testing of the Product to verify any warranty claim.

F. Product which has had the serial number removed or made illegible.

G. Rechargeable batteries if:

H. any of the seals on the battery enclosure of cells are broken or show evidence of tampering.

I. the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.

J. Freight costs to the repair depot.

K. A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with MOTOROLA's published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from MOTOROLA.

L. Scratches or other cosmetic damage to Product surfaces that does not affect the operation of the Product.

M. Normal and customary wear and tear.

VI. Patent And Software Provisions

MOTOROLA will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and MOTOROLA will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim, but such defense and payments are conditioned on the following:

A. that MOTOROLA will be notified promptly in writing by such purchaser of any notice of such claim;

B. that MOTOROLA will have sole control of the defense of such suit and all negotiations for its settlement or compromise; and

C. should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by MOTOROLA.

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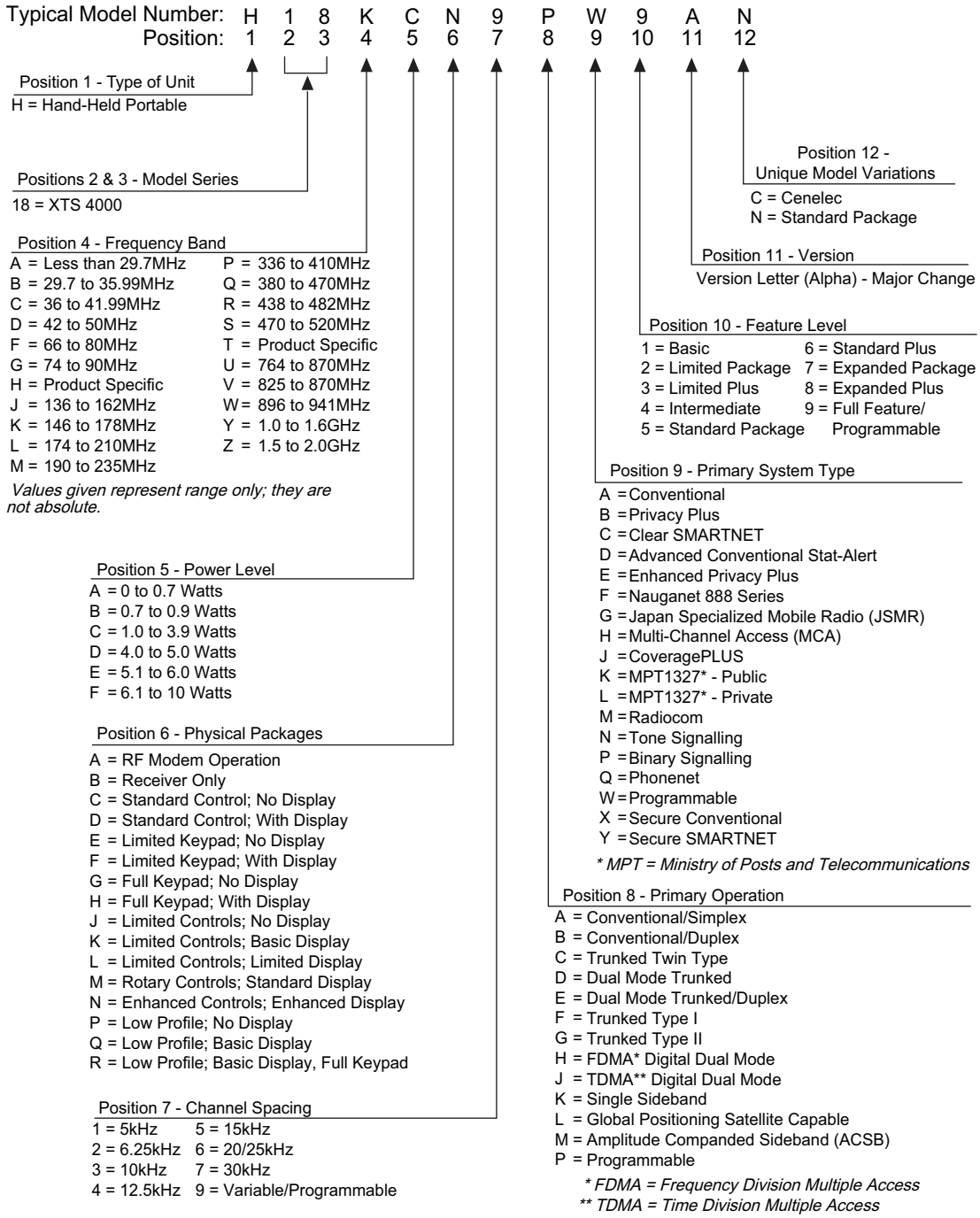
VII. Governing Law

This Warranty is governed by the laws of the State of Illinois, USA.

Model Numbering, Charts, and Specifications

Portable Radio Model Numbering System


Typical Model Number: H 1 8 K C N 9 P W 9 A N
Position: 1 2 3 4 5 6 7 8 9 10 11 12
Position 1 - Type of Unit
H = Hand-Held Portable
Positions 2 & 3 - Model Series
18 = XTS 4000
Position 4 - Frequency Band
A = Less than 29.7MHz
B = 29.7 to 35.99MHz
C = 36 to 41.99MHz
D = 42 to 50MHz
F = 66 to 80MHz
G = 74 to 90MHz
H = Product Specific
J = 136 to 162MHz
K = 146 to 178MHz
L = 174 to 210MHz
M = 190 to 235MHz
P = 336 to 410MHz
Q = 380 to 470MHz
R = 438 to 482MHz
S = 470 to 520MHz
T = Product Specific
U = 764 to 870MHz
V = 825 to 870MHz
W = 896 to 941MHz
Y = 1.0 to 1.6GHz
Z = 1.5 to 2.0GHz
Values given represent range only; they are not absolute.
Position 5 - Power Level
A = 0 to 0.7 Watts
B = 0.7 to 0.9 Watts
C = 1.0 to 3.9 Watts
D = 4.0 to 5.0 Watts
E = 5.1 to 6.0 Watts
F = 6.1 to 10 Watts
Position 6 - Physical Packages
A = RF Modem Operation
B = Receiver Only
C = Standard Control; No Display
D = Standard Control; With Display
E = Limited Keypad; No Display
F = Limited Keypad; With Display
G = Full Keypad; No Display
H = Full Keypad; With Display
J = Limited Controls; No Display
K = Limited Controls; Basic Display
L = Limited Controls; Limited Display
M = Rotary Controls; Standard Display
N = Enhanced Controls; Enhanced Display
P = Low Profile; No Display
Q = Low Profile; Basic Display
R = Low Profile; Basic Display, Full Keypad
Position 7 - Channel Spacing
1 = 5kHz
2 = 6.25kHz
3 = 10kHz
4 = 12.5kHz
5 = 15kHz
6 = 20/25kHz
7 = 30kHz
9 = Variable/Programmable
Position 8 - Primary Operation
A = Conventional/Simplex
B = Conventional/Duplex
C = Trunked Twin Type
D = Dual Mode Trunked
E = Dual Mode Trunked/Duplex
F = Trunked Type I
G = Trunked Type II
H = FDMA* Digital Dual Mode
J = TDMA** Digital Dual Mode
K = Single Sideband
L = Global Positioning Satellite Capable
M = Amplitude Companded Sideband (ACSB)
P = Programmable
* FDMA = Frequency Division Multiple Access
** TDMA = Time Division Multiple Access
Position 9 - Primary System Type
A = Conventional
B = Privacy Plus
C = Clear SMARTNET
D = Advanced Conventional Stat-Alert
E = Enhanced Privacy Plus
F = Nauganet 888 Series
G = Japan Specialized Mobile Radio (JSMR)
H = Multi-Channel Access (MCA)
J = CoveragePLUS
K = MPT1327* - Public
L = MPT1327* - Private
M = Radiocom
N = Tone Signalling
P = Binary Signalling
Q = Phonenet
W = Programmable
X = Secure Conventional
Y = Secure SMARTNET
* MPT = Ministry of Posts and Telecommunications
Position 10 - Feature Level
1 = Basic
2 = Limited Package
3 = Limited Plus
4 = Intermediate
5 = Standard Package
6 = Standard Plus
7 = Expanded Package
8 = Expanded Plus
9 = Full Feature/ Programmable
Position 11 - Version
Version Letter (Alpha) - Major Change
Position 12 - Unique Model Variations
C = Cenelec
N = Standard Package

ASTRO XTS 4000 VHF Model Chart

	MODEL NUMBER	DESCRIPTION
	H18KCN9PW9AN	XTS4000 PORTABLE ASTRO DIGITAL 136–174MHZ 1–2W

		ITEM NUMBER	DESCRIPTION
X		NUD2897_	XTS 4000 VHF Tanapa
X		NUD7115_	XTS 4000 VHF Main
X		NNTN7097_	XTS 4000 UCM Board
X		NNTN7098_	Hardware, Tanapa XTS4000
X		NNTN7101_	Assembly, Chassis XTS4000
X		NNTN7100_	Assembly, Keypad Backer, XTS4000
X		NNTN7099_	Assembly, Flip Front Housing, XTS4000
X		PMLN5057_	XTS4000 CD UG & Safety
X		6871618L01	XTS4000 User Guide

Notes:

X *=Item Included*

* • *The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.*

• *The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting the radio into the Test Mode.*

• *The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (NKN1027_ or NKN1029_) and the CPS to read the radio.*

ASTRO XTS 4000 UHF Model Chart

	MODEL NUMBER	DESCRIPTION
	H18QCN9PW9AN	XTS4000 PORTABLE ASTRO DIGITAL 380–470MHZ 0.25–2W

		ITEM NUMBER	DESCRIPTION
X		NUE3623_	XTS 4000 UHF Tanapa
X		NUE7350_	XTS 4000 UHF Main
X		NNTN7097_	XTS 4000 UCM Board
X		NNTN7098_	Hardware, Tanapa XTS4000
X		NNTN7101_	Assembly, Chassis XTS4000
X		NNTN7100_	Assembly, Keypad Backer, XTS4000
X		NNTN7099_	Assembly, Flip Front Housing, XTS4000
X		PMLN5057_	XTS4000 CD UG & Safety
X		6871618L01	XTS4000 User Guide

Notes:

X *= Item Included*

* *• The model number and (sometimes) the FLASHcode can be found on the FCC label on the back of the radio.*

• The model number, Host code, DSP code, and (sometimes) the FLASHcode can be found by putting the radio into the Test Mode.

• The model number, Host code, DSP code, and FLASHcode can be found by using the Programming Cable (NKN1027_ or NKN1029_) and the CPS to read the radio.

Specifications for VHF Radios

All specifications are per Telecommunications Industries Association TIA-603 unless otherwise noted.

GENERAL	RECEIVER (TYPICAL PERFORMANCE)	TRANSMITTER (TYPICAL PERFORMANCE)
FCC Designation: AZ489FT3814	**Bandwidth:** 38 MHz	**RF Power:**
Frequency Ranges: (Subject to Antenna operating band - See Appendix A: Antennas) 136–151 MHz, 145–166 MHz, 162–174 MHz	**Frequency Stability (-30 to +60°C; 25°C ref.):** ±0.0002%	**136–174 MHz:** 1–2 Watts
Temperature Range:	**Rated Audio:** 500 mW	**Frequency Stability (typical) (-30 to +60°C; 25°C ref.):** ±0.0002%
Operating: -30°C to +60°C	**Analog Sensitivity***	**Emission (typical conducted):** -75 dBc
Storage: -40°C to +85°C	**12 dB SINAD:** 0.22 µV	**FM Hum and Noise***
Power Supply: Lithium-Ion Battery (Li-Ion)	**Selectivity***	**12.5 kHz Channel:** -43 dB
Battery Voltage:	**12.5 kHz Channel:** -67 dB	**25 kHz Channel:** -48 dB
Nominal: 7.5 Vdc	**25 kHz Channel:** -78 dB	**Distortion*:** 1.0%
Range: 6 to 9 Vdc	**Intermodulation*:** -75 dB	**Modulation Limiting***
Transmit Current Drain (Typical): 950 mA	**Spurious Rejection*:** -75 dB	**12.5 kHz Channel:** ±2.5 kHz
Receive Current Drain (Rated Audio): 210 mA	**FM Hum and Noise*:**	**25 kHz Channel:** ±5.0 kHz
Standby Current Drain: 89 mA	**12.5 kHz Channel:** -45 dB	**Adjacent Channel Power Ratio***
Recommended Battery:	**25 kHz Channel:** -50 dB	**12.5 kHz Channel:** -67 dB
630 mAh Li-Ion: NNTN6944_	**Distortion*:** 1.50%	**25 kHz Channel:** -78 dB
or **1260 mAh Li-Ion:** PMNN4083_	**Digital Sensitivity****	**Modulation Fidelity****
Dimensions (H x W x D):	**1% BER:** 0.25 µV	**Deviation:** 1750 Hz
Radio Only (w/o battery, w/o antenna): 4.06" x 2.18" x 1.17" (103.2 mm x 55.3 mm x 29.6 mm)	**5% BER:** 0.22 µV	**Carrier Frequency Offset:** ±0.0002%
Radio With 630 mAh Li-Ion (NNTN6944_) Only (w/o antenna): 4.06" x 2.18" x 1.36" (103.2 mm x 55.3 mm x 34.6 mm)	**Selectivity**:** -63 dB	**Error Vector Magnitude:** 1.5%
Radio With 1260 mAh Li-Ion (PMNN4083_) Only (w/o antenna): 4.06" x 2.18" x 1.58" (103.2 mm x 55.3 mm x 40.2 mm)	**Intermodulation**:** -73 dB	**Symbol Rate Accuracy**:** 0%
Weight: (w/ Antenna):	**Spurious Rejection**:** -75 dB	**Adjacent Channel Power Ratio**:** -69 dB
Less Battery: 5.6 oz (160 g)	**Residual Audio Noise Ratio (silence)**:** -65 dB	
With 630 mAh Li-Ion (NNTN6944_): 7.8 oz (220 g)	**Residual Audio Noise Power (mute)**:** -65 dBm	
With 1260 mAh Li-Ion (PMNN4083_): 9.9 oz (280 g)	**Distortion**:** 1.00%	**Emissions Designators:** 20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and 8K10F1E

Specifications subject to change without notice.

Notes:

** Measured in ANALOG mode per TIA/EIA 603 under nominal conditions.*

*** Measured in DIGITAL mode per TIA/EIA IS 102.CAAA under nominal conditions.*

Specifications for UHF Range 1 Radios

All specifications are per Telecommunications Industries Association TIA-603 unless otherwise noted.

GENERAL		RECEIVER (TYPICAL PERFORMANCE)		TRANSMITTER (TYPICAL PERFORMANCE)	
FCC Designation:	AZ489FT4881	**Bandwidth:**	90 MHz	**RF Power:**	
				380–470 MHz:	0.25–2 Watts
Frequency Ranges:	380–470 MHz				
(Subject to Antenna operating band - See Appendix A: Antennas)		**Frequency Stability**		**Frequency Stability (typical)**	
		(-30 to +60°C; 25°C ref.):	±0.0002%	**(-30 to +60°C; 25°C ref.):**	±0.0002%
Temperature Range:					
Operating:	-30°C to +60°C	**Rated Audio:**	500 mW	**Emission (typical conducted):**	-75 dBc
Storage:	-40°C to +85°C				
		Analog Sensitivity*		**FM Hum and Noise***	
Power Supply:	Lithium-Ion Battery (Li-Ion)	**12 dB SINAD:**	0.25 µV	**12.5 kHz Channel:**	-40 dB
				25 kHz Channel:	-43 dB
Battery Voltage:		**Selectivity***			
Nominal:	7.5 Vdc	**12.5 kHz Channel:**	-63 dB	**Distortion*:**	1.2%
Range:	6 to 9 Vdc	**25 kHz Channel:**	-73 dB		
				Modulation Limiting*	
Transmit Current Drain (Typical):	950 mA	**Intermodulation*:**	-70 dB	**12.5 kHz Channel:**	±2.5 kHz
Receive Current Drain (Rated Audio):	210 mA			**25 kHz Channel:**	±5.0 kHz
Standby Current Drain:	89 mA	**Spurious Rejection*:**	-75 dB		
				Adjacent Channel Power Ratio*	
Recommended Battery:		**FM Hum and Noise*:**		**12.5 kHz Channel:**	-67 dB
630 mAh Li-Ion:	NNTN6944_	**12.5 kHz Channel:**	-40 dB	**25 kHz Channel:**	-75 dB
or **1260 mAh Li-Ion:**	PMNN4083_	**25 kHz Channel:**	-45 dB		
Dimensions (H x W x D):		**Distortion*:**	2%		
Radio Only (w/o battery, w/o antenna):		**Digital Sensitivity****		**Modulation Fidelity****	
4.06" x 2.18" x 1.17"		**1% BER:**	0.25 µV	**Deviation:**	1630 Hz < UHF1 < 1800 Hz
(103.2 mm x 55.3 mm x 29.6 mm)		**5% BER:**	0.25 µV	**Carrier Frequency Offset:**	±0.0002%
Radio With 630 mAh Li-Ion (NNTN6944_) Only (w/o antenna):				**Error Vector Magnitude:**	< 5%
		Selectivity:**	-63 dB		
4.06" x 2.18" x 1.36"				**Symbol Rate Accuracy**:**	0%
(103.2 mm x 55.3 mm x 34.6 mm)		**Intermodulation**:**	-70 dB		
Radio With 1260 mAh Li-Ion (PMNN4083_) Only (w/o antenna):				**Adjacent Channel Power Ratio**:**	-67 dB
		Spurious Rejection:**	-75 dB		
4.06" x 2.18" x 1.58"					
(103.2 mm x 55.3 mm x 40.2 mm)		**Residual Audio Noise Ratio (silence)**:**	-65 dB		
		Residual Audio Noise Power (mute):**	-53 dBm		
Weight: (w/ Antenna):		**Distortion**:**	1.00%		
Less Battery:	5.6 oz (160 g)				
With 630 mAh Li-Ion (NNTN6944_):					
7.8 oz (220 g)					
With 1260 mAh Li-Ion (PMNN4083_):					
9.9 oz (280 g)					
				Emissions Designators:	
				20K0F1E, 16K0F3E, 11K0F3E, 8K10F1D, and 8K10F1E	

Specifications subject to change without notice.

Notes:

** Measured in ANALOG mode per TIA/EIA 603 under nominal conditions.*

*** Measured in DIGITAL mode per TIA/EIA IS 102.CAAA under nominal conditions.*

Notes

Chapter 1 Introduction

This manual contains information needed for Levels One and Two radio servicing. Level One servicing consists of radio programming, radio alignment, and installation and removal of the antenna and battery. Level Two servicing covers disassembly and reassembly of the radio to replace circuit boards.

1.1 Manual Contents

Included in this manual are radio specifications for the VHF (136–174 MHz) and UHF (380–470 MHz) frequency bands, a general description of XTS 4000 model, recommended test equipment, service aids, radio alignment procedures, general maintenance recommendations, procedures for assembly and disassembly, and exploded views and parts lists.

1.2 Notations Used in This Manual

Throughout the text in this publication, you will notice the use of note, caution, warning, and danger notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.

NOTE: An operational procedure, practice, or condition that is essential to emphasize.

CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or injury.

1.3 Radio Description

The ASTRO XTS 4000 radios are among the most sophisticated two-way radios available. The radios are available in the VHF (136–174 MHz) and UHF (380–470 MHz) frequency bands.

The ASTRO XTS 4000 radio provides improved voice quality across more coverage area. The digital process, called *embedded signaling*, intermixes system signaling information with digital voice, resulting in improved system reliability and the capability of supporting a multitude of advanced features.

Table 1–1 describes the basic features of ASTRO XTS 4000 radios.

Table 1–1. ASTRO XTS 4000 Basic Features

Feature	XTS4000
Main Display	130 x130 dot matrix, liquid-crystal display (LCD)
CID Display	112 x 32 dot matrix, liquid-crystal display (LCD)
Keypad	3 x 3 Menu Keypad (with 4-way Navigation button) 3 x 4 Alphanumeric Keypad
Channel Capability	850
Dialing from Prestored List	Yes
Programmable Softkeys	Yes

1.4 FLASHport®

The ASTRO XTS 4000 radio utilizes Motorola's FLASHport technology. FLASHport makes it possible to add software that drives the radio's capabilities both at the time of purchase and later on. Previously, changing a radio's features and capabilities meant significant modifications or buying a new radio. But now, similar to how a computer can be loaded with different software, the radio's features and capabilities can be upgraded with FLASHport software.

Chapter 2 Basic Maintenance

This chapter describes preventive maintenance and handling precautions. Each of these topics provides information vital to the successful operation and maintenance of your radio.

2.1 General Maintenance

In order to avoid operating outside the limits set by the FCC, we recommend that you align the ASTRO XTS 4000 radio's reference oscillator every time the radio is taken apart, or once per year, whichever comes first. Periodic visual inspection and cleaning is also recommended.

2.1.1 Inspection

Check that the external surfaces of the radio are clean and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed.

2.1.2 Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external surfaces of the radio. External surfaces include the housing assembly and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water.

The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, and other chemicals should be avoided.

The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lintless cloth or tissue should be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

2.2 Handling Precautions

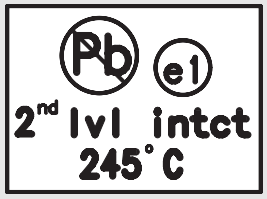
Complementary metal-oxide semiconductor (CMOS) devices, and other high-technology devices, are used in this family of radios. While the attributes of these devices are many, their characteristics make them susceptible to damage by electrostatic discharge (ESD) or high-voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair. Handling precautions are mandatory for this radio, and are especially important in low-humidity conditions.

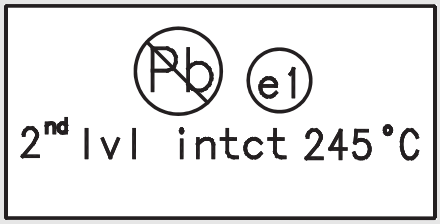
Caution

- The XTS 4000 radio casting has a vent port that allow for pressure equalization in the radio. Never poke this vent with any object, such as needles, tweezers, or screwdrivers. This could create a leak path into the radio.
- The pressure equalization vent is located on the chassis, just below the battery contact. Never obstruct or cover the slot with any object, except the designated Audio Jack PC Label (48). Ensure that no oily substances come in contact with this vent.

2.3 General Repair Procedures and Techniques

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards — examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's **Restriction of Hazardous Substances (ROHS) Directive 2002/95/EC** and **Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC.** To maintain product compliance and reliability, use only the Motorola specified parts in this manual.





Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following table:

Table 2–1. Lead Free Solder Wire Part Number List

Motorola Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diameter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7–3.2%	217C	52171	0.015"	1lb spool

Table 2–2. Lead Free Solder Paste Part Number List

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
1085674C03	NC-SMQ230	900–1000KCPs Brookfield (5rpm)	Type 3 (-325/+500)	(95.5%Sn–3.8%Ag-0.7%Cu) 89.3%	217°C

2.3.1 Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the component from the nearest Motorola Radio Products and Solutions Organization listed in Appendix B of this manual.

2.3.2 Rigid Circuit Boards

The family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The through-plated holes may interconnect multiple layers of the printed circuit. Therefore, care should be exercised to avoid pulling the plated circuit out of the hole.

When soldering near the connector pins:

- avoid accidentally getting solder in the connector.
- be careful not to form solder bridges between the connector pins
- closely examine your work for shorts due to solder bridges.

2.3.3 Chip Components

Use the RLN4062 Hot-Air Repair Station for chip component replacement. Adjust the temperature control to 390 °C (735 °F), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- **To remove a chip component**:
  1. Use a hot-air hand piece and position the nozzle of the hand piece approximately 0.3 cm (1/8”) above the component to be removed.
  2. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers.
  3. Using a solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.
- **To replace a chip component using a soldering iron**:
  1. Select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads.
  2. Using a pair of tweezers, position the new chip component in place while heating the fresh solder.
  3. Once solder wicks onto the new component, remove the heat from the solder.
  4. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- **To replace a chip component using hot air**:
  1. Use the hot-air hand piece and reflow the solder on the solder pads to smooth it.
  2. Apply a drop of solder paste flux to each pad.
  3. Using a pair of tweezers, position the new component in place.
  4. Position the hot-air hand piece approximately 0.3 cm (1/8”) above the component and begin applying heat.
  5. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

2.3.4 Shields

Removing and replacing shields is recommended to be done with the Air Blower, BOSCH GHG 603 or equivalent.

- **To remove the shield**:
  1. Place the circuit board in the circuit board holder.
  2. Add solder paste flux around the base of the shield.
  3. Position the heat-focus head onto the shield.
  4. Turn on the heater and wait until the shield lifts off the circuit board.
  5. Once the shield is off, turn off the heat, and grab the part with a pair of tweezers.
  6. Remove the circuit board from the circuit board holder.
- **To replace the shield:**
  1. Add solder to the shield if necessary, using a micro-tipped soldering iron.
  2. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board.
  3. Place the circuit board back in the circuit board holder.
  4. Place the shield on the circuit board using a pair of tweezers.
  5. Position the heat-focus head over the shield.
  6. Turn on the heater and wait for the solder to reflow.
  7. Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool.
  8. Remove the circuit board and inspect the repair. No cleaning should be necessary.

Chapter 3 Basic Theory of Operation

This chapter discusses the basic operational theory of the ASTRO XTS 4000 radio, which is a wideband, synthesized radio available in the VHF (136–174 MHz) and UHF (380–470 MHz) frequency bands. All ASTRO XTS 4000 radios are capable of ASTRO mode (digital) operation (12.5 kHz).

3.1 Major Assemblies

The ASTRO XTS 4000 radio includes the following major connections to the main board (See Figure 3–1):

- **Main Board** – contains a dual-core processor which includes both the microcontroller unit (MCU) and a digital signal processor (DSP) core, the processor's memory devices, an audio and power supply support integrated circuit (IC), a digital support IC, and the audio power amplifier. It also contains all transmit, receive, and frequency generation circuitry, including the digital receiver back-end IC and the reference oscillator.
- **CE-UCM Flex** – contains vibrator, speaker, microphone and encryption connector.
- **Main Display** – 130 x 130 dot matrix, liquid-crystal display (LCD).
- **CID Display** – 112 x 32 dot matrix, liquid-crystal display (LCD).
- **Keypad** – a 3 x 3 Menu keypad with 4-way navigation button, and a 3 x 4 alphanumeric keypad.

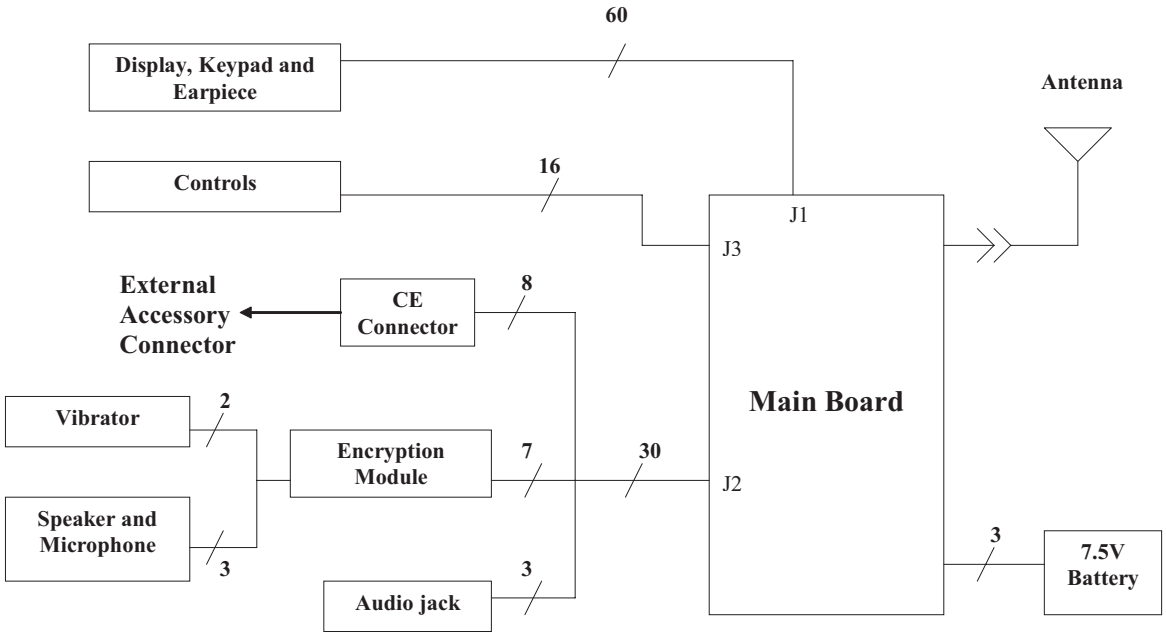


Figure 3–1. XTS 4000 Overall Block Diagram

3.2 Digital Mode of Operation

This section provides an overview of the digital mode receive and transmit theory of operation.

3.2.1 Receiving

When the radio is *receiving (*See Figure 3–2), the signal comes from the antenna connector to the Main board, passing through the antenna switch and the receiver front end. The signal is then filtered, amplified, and mixed with the first local-oscillator signal, generated by the voltage-controlled oscillator (VCO).

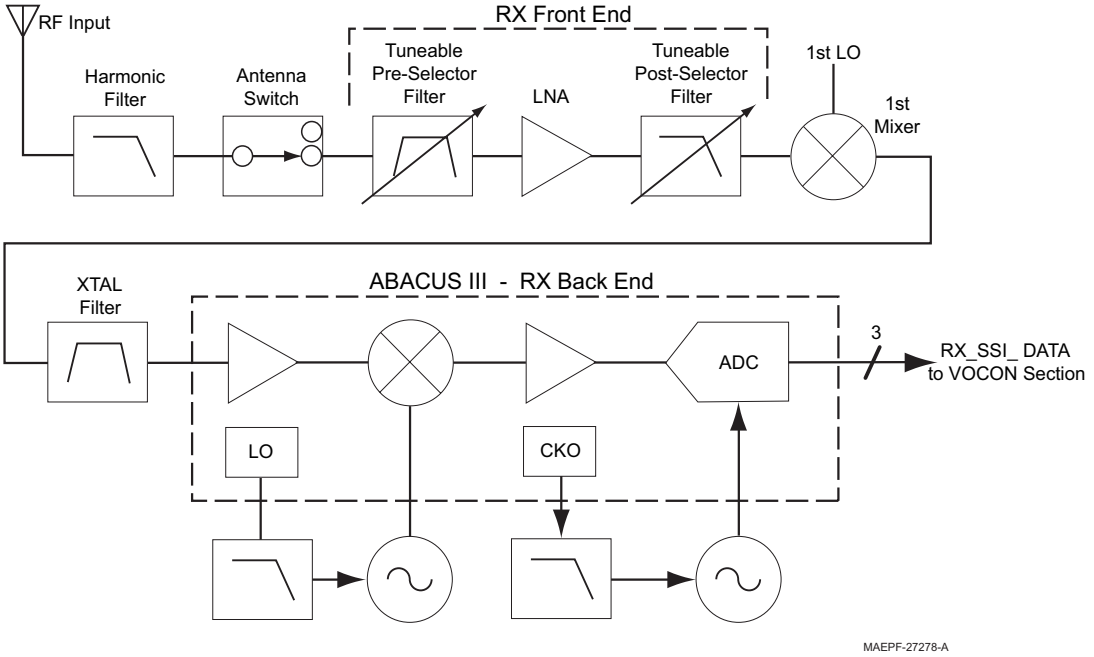


Figure 3–2. Receiver Block Diagram

The resulting intermediate frequency (IF) signal is fed to the IF circuitry, where it is again filtered and passed to the Abacus III digital back-end IC. In the digital back-end IC, the IF signal is mixed with the second local oscillator to create the second IF at 2.25 MHz. In the back-end IC, a bandpass, sigma-delta, analog-to-digital converter then decodes the second IF signal, and outputs, on the radio's serial synchronous interface (SSI) bus, digital audio to the digital signal processor (DSP).

The dual-core processor's digital-signal processor (DSP) digitally filters the PCM audio. The DSP decodes the information in the signal and identifies the appropriate destination for it.

- For a voice signal, the DSP will route the digital voice data to the CODEC inside the audio and power supply support IC, for conversion to an analog signal. The CODEC will then present the signal to the receive audio pre-amplifier, then to the audio power amplifier, which drives the speaker.
- For signaling information, the DSP will decode the message and pass it internally to the microcontrol unit of the dual-core processor.

3.2.2 Transmitting

When the radio is *transmitting*, microphone audio is passed through gain stages to the CODEC, where the signal is digitized. The CODEC passes digital data to the DSP, where pre-emphasis and low-pass (splatter) filtering are done. The DSP passes this signal to a digital/analog converter (DAC), where it is reconverted into an analog signal and scaled for application to the voltage-controlled oscillator as a modulation signal (See Figure 3–3).

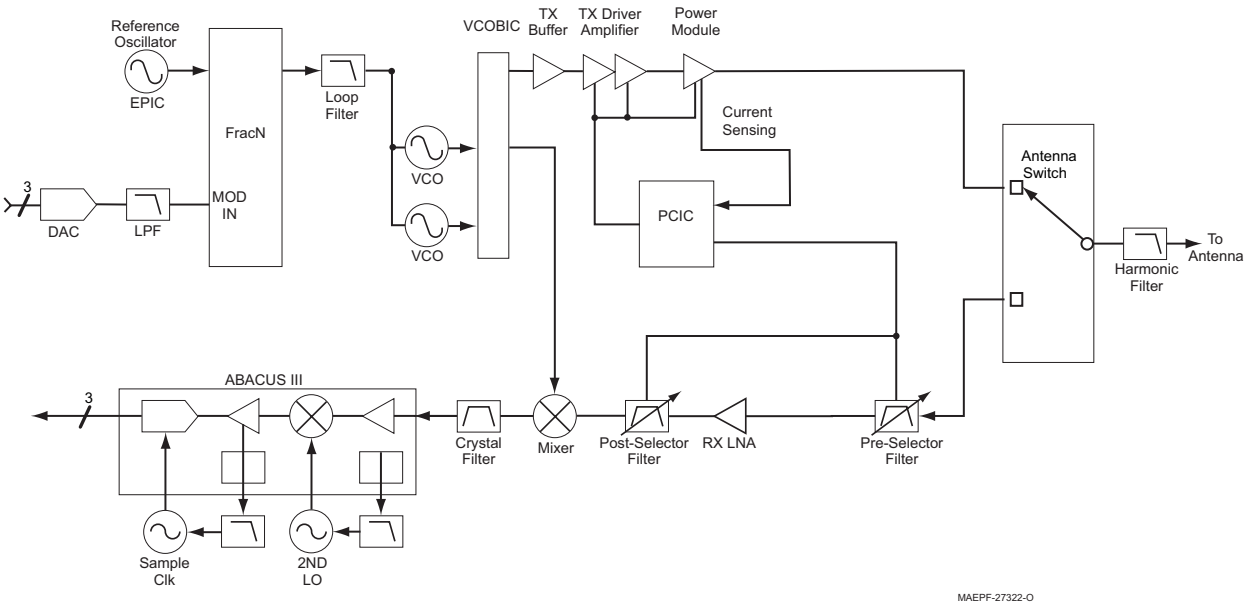


Figure 3–3. Transceiver (VHF) Block Diagram (Power and Control Omitted)

Transmitted signaling information is applied to the DSP from the microcontrol unit, where it is coded, and passed to the DAC, which handles it the same as a voice signal. The DAC output connects to the synthesizer modulation input. A modulated carrier is provided to the transmitter power amplifier, which transmits the signal under dynamic power control.

3.3 Main Board

3.3.1 Transceiver Operation

Refer to Figure 3–3, on page 3-3. The receiver front end consists of a pre-selector filter, low-noise amplifier, a post-selector filter, and a mixer. Both the pre-selector filter and pro-selector filter are varactor-tuned bandpass filters, controlled by the microcontroller. See Table 3–1 for local oscillator (LO) and first IF information.

Table 3–1. Local Oscillator and First IF Frequencies

	VHF	UHF1
LO Frequency Range	180.85–218.85 MHz	306.65–396.65 MHz
First IF Frequency	44.85 MHz	73.35 MHz

The frequency generation function is performed by two ICs - two VCOs, and associated circuitry. The reference oscillator IC provides a frequency standard to the synthesizer. The fractional-N synthesizer turns on the two external VCOs and tunes it to RX LO or TX carrier frequency. The VCO buffer amplifies the signal to the required power level. The synthesizer is controlled by the microcontroller unit through a serial peripheral interface (SPI) bus. Most of the synthesizer circuitry is enclosed in rigid metal cans on the transceiver section to reduce interference and microphonic effects.

The receiver back end consists of a bandpass crystal filter, input and output impedance matching networks, and the digital back-end IC. Final filtering is done digitally in the DSP.

The Abacus III digital back-end IC contains a low-noise amplifier, a mixer, a variable gain amplifier with integral anti-alias filter, a bandpass, sigma delta, analog-to-digital converter, and a decimation filter with a programmable decimation factor. The Abacus III also contains an automatic gain control (AGC) circuit to provide 12 dB of continuous gain adjustments. For the second LO, the Abacus III has an internal, integer-N frequency synthesizer, and an external, discrete loop filter and voltage-controlled oscillator (VCO). The output of the Abacus III is digital data on the RX_SSI bus.

The transmitter power amplifier (PA) consists of a driver amplifier IC and a discrete final-stage. Transmit power is controlled by a power control IC (PCIC) that monitors the currents and adjusts PA control voltages. The transmitter RF signal then passes through a PIN diode antenna switch and a low-pass harmonic filter, which connects to the antenna connector.

3.3.2 VOCON Operation

The vocoder and controller (VOCON) circuitry contains the radio's microcontroller unit (Patriot) with its memory and support circuits, the DSP, its memory devices, and the DSP-support IC, voltage regulators, audio, and power control circuits. Connected to the VOCON circuitry are the display circuitry, RF circuitry, keypad circuitry, encryption module, microphone, speaker and vibrator.

The microcontrol unit controls receive/transmit frequencies, power levels, display, and other radio functions, using either direct logic control or serial communications paths to the devices.The microcontrol unit executes a stored program located in the FLASH ROM. Data is transferred to and from memory by the microcontrol unit data bus. The memory location from which data is read, or to which data is written, is selected by the address lines.

The DSP-support IC is supplied with a 16.8 MHz clock from the RF circuitry. Both the DSP and the microprocessor have their clocks generated by the DSP-support IC. They can both be adjusted so that the harmonics do not cause interference with the radio’s receive channel.

The regulator and power-control circuits include 3.3-volt analog, 3.3-volt digital, and 5-volt regulators. The audio PA is sourced from 7.5V. The regulator’s power-down mode is controlled by the microcontrol unit, which senses the on/off button.

The DSP performs signalling and voice encoding and decoding, as well as audio filtering and volume control. This IC performs Private-Line®/Digital Private Line™ (PL/DPL) encode and alert-tone generation. The IC transmits pre-emphasis on analog signals and applies a low-pass (splatter) filter to all transmitted signals. It requires a clock on the EXTAL pin. An 8 kHz interrupt signal generated by the DSP-support IC is also required for functionality. It is programmed using parallel programming from the microcontrol unit.

The audio CODEC performs analog-to-digital (A/D), and digital-to-analog conversions on audio signals. The DSP controls squelch, deviation, and executes receiver and transmitter filtering. The DSP-support IC receives a 2.4 MHz clock, and also receives data, which it formats for the DSP.

Chapter 4 Recommended Test Equipment and Service Aids

This chapter provides lists of recommended test equipment and service aids, as well as information on field programming equipment that can be used in servicing and programming ASTRO XTS 4000 radios.

4.1 Recommended Test Equipment

The list of equipment contained in Table 4–1 includes all of the standard test equipment required for servicing two-way portable radios, as well as several unique items designed specifically for servicing this family of radios. The “Characteristics” column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

Table 4–1. Recommended Test Equipment

Motorola Model Number	Description	Characteristics	Application
Service Monitor	Can be used as a substitute for items marked with an asterisk (*)	Aeroflex 2975 (www.aeroflex.com), Motorola R2670, or equivalent	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter *	100 µV to 300 V 5 Hz to 1 MHz 10 Mega Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements
RF Signal Generator *	100 MHz to 1 GHz -130 dBm to +10 dBm FM Modulation 0 kHz to 10 kHz Audio Frequency 100 Hz to 10 kHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
Oscilloscope *	2 Channel 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 (www.leaderusa.com), Tektronix TDS1001b (www.tektronix.com), or equivalent	Waveform measurements
Power Meter and Sensor *	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements
Power Supply	0 V to 32 V 0 A to 20 A	B&K Precision 1790 (www.bkprecision.com) or equivalent	Voltage supply

4.2 Service Aids

Refer to Table 4–2 for a listing and description of the service aids designed specifically for servicing this family of radios. These kits and/or parts are available from the Radio Products Services Division offices listed in “Appendix B Replacement Parts Ordering” on page B-1. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 4–2. Service Aids

Motorola Part Number	Description	Application
0182297T15	XTS 4000 Keyload Cable	Used to load encryption key into radio. Connects to radio's CE connector and key-variable loader (KVL).
NKN1027	RS232 Cable Kit	Connects radio to RLN-4460 Portable Test Set for radio performance checks, and to serial port on personal computer for CPS programming and tuner alignments.
NKN1029	USB Cable Kit	Connects radio to RLN-4460 Portable Test Set for radio performance checks, and to Universal Serial Bus (USB) port on personal computer for CPS programming and tuner alignments.
NNTN7151	Housing Eliminator	Fixture that allows radio’s internal board to be mounted externally. Provides easy access to electronic circuits, required for board-level troubleshooting.
NNTN7152	Regulated Battery Eliminator, XTS 4000	Used in place of battery to connect radio to an external power supply.
NNTN7153	SMA Conversion RF Adapter	Adapts radio’s antenna port to RF cabling of test equipment.
RLN4460	Portable Test Set	Used for radio performance checks. Connects to radio’s CE connector and allows remote switching and signal injection/ outputs for test equipment measurements.
RVN4181	Customer Programming Software (CPS) and Tuner Software	CPS allows customer-specific programming of modes and features. Tuner software required to perform alignment of radio parameters. Can be used for XTS 5000, XTS 4000 and XTS 2500 products.

4.3 Field Programming

This family of radios can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the online help in the Customer Programming Software (CPS) for complete field programming information.

Chapter 5 Performance Checks

This chapter covers performance checks used to ensure that the ASTRO XTS 4000 radio meets published specifications. The recommended test equipment listed in the previous section approaches the accuracy of the manufacturing equipment, with a few exceptions. Accuracy of the test equipment must be maintained in compliance with the manufacturer's recommended calibration schedule. Checks should be performed if radio performance degradation is suspected.

5.1 Test Equipment Setup

Supply voltage can be connected from the battery eliminator. The equipment required for the performance checks is connected as shown in Figure 5–1.

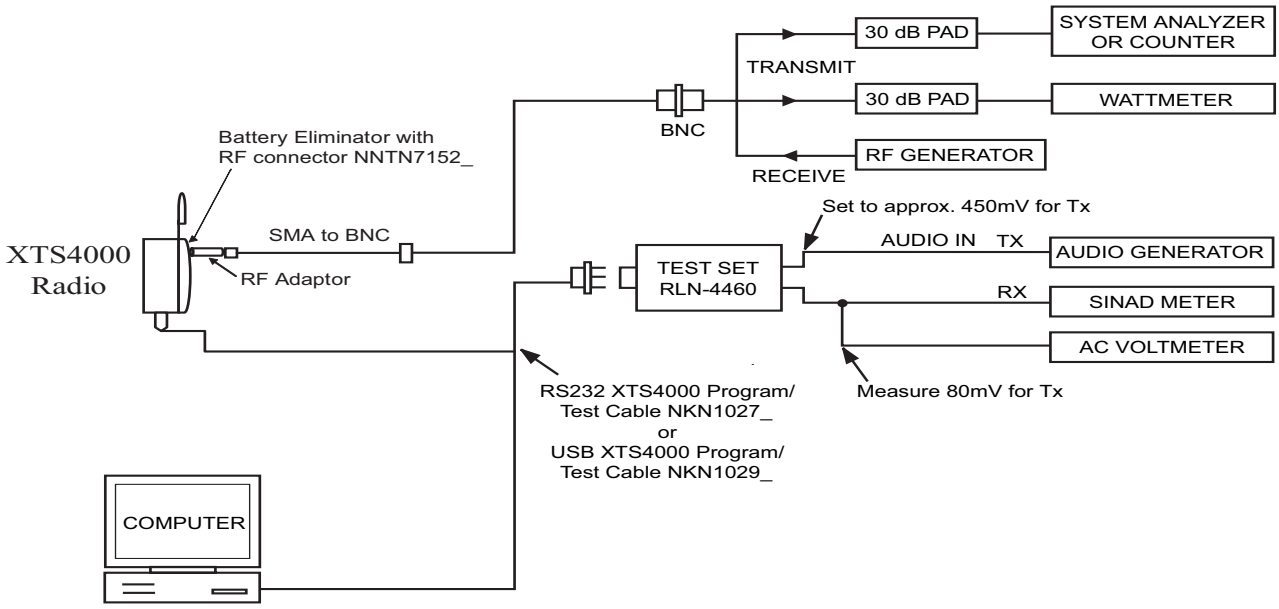


Figure 5–1. Performance Checks Test Setup

Initial equipment control settings should be as indicated in Table 5–1 and should be the same for all performance checks and alignment procedures, except as noted.

Table 5–1. Initial Equipment Control Settings

System Analyzer	Test Set	Power Supply
Monitor Mode: Standard*	**Spkr/Load:** Speaker	**Voltage:** 7.5 Vdc
Receiver Checks **RF Control:** GEN **Output Level:** -47 dBm **Modulation:** 1 kHz tone @1.5 kHz deviation **Frequency:** Set to selected radio RX frequency **Meter:** AC Volts Transmitter Checks **RF Control:** MONITOR **Frequency:** Set to selected radio TX frequency **Meter:** RF Display **Modulation Type:** FM **Attenuation:** 20 dB	**PTT:** OFF (center)	**DC On/Standby:** Standby
	Meter Out: RX	**Volt Range:** 10 Vdc
	Opt Sel: ON	**Current:** 2.5 Amps

* *This Initial Equipment Control Settings is for 12.5 kHz channel spacing only.*

** *Use "PROJ 25 STD" if testing ASTRO Conventional channels.*

5.2 Display Radio Test Mode

This section provides instructions for performing tests in display radio test mode.

5.2.1 Test Mode Menu

Test Modes available after power up,

- **If flip is Opened**:

  RF test → CH test → RGB test → Vibration test

- **If flip is Closed:**

  RF test → CH test → CID test → Vibration test

5.2.2 Access the Test Mode

To enter the display radio test mode:

1. Turn the radio on.

NOTE: To access the Test Mode from the external display, close the flip once the radio is power up.

2. Within 10 seconds after "SELF TEST" is complete, press the **Side Button** five times in succession.

   The radio shows a series of displays that give information regarding various version numbers and subscriber specific information. The displays are described in Table 5–2.

Table 5–2. Test-Mode Displays

Name of Display	Description	Appears
"SERVICE"	The literal string indicates the radio has entered test mode.	Always
Host Software Version	The version of host firmware is displayed.	Always
DSP Software Version	The version of DSP firmware is displayed.	Always
EMC Secure Version	Version of the encryption hardware	When the radio is secure equipped
Encryption Type 1	Type of encryption being used	When the radio is secure equipped
Encryption Type 2	Type of encryption being used	When the radio is secure equipped
Model Number	The radio's model number as programmed in the codeplug	Always
Serial Number	The radio's serial number, as programmed in the codeplug	Always
ESN Number	The radio's Electronic Serial Number as programmed in the codeplug	Always
ROM Size	The memory capacity of the host FLASH part	Always
FLASH Code	The FLASH codes as programmed in the codeplug	Always
RF Band	The radio's RF band as programmed in the Tuning codeplug	Always
Tuning Codeplug Version	Version of the Tuning codeplug being used	Always
Processor Version	Version of the processor being used	Always

NOTE: All displays are temporary and will expire without any user intervention. If information is longer than the physical length of the radio's display, the information will wrap around to the next display. After the last display, "RF test" is displayed.

To freeze any of the displays, press the Left Navigation Button. To resume automatic scrolling, press the Right Navigation Button. To rapidly scroll forward through the displays, continue pressing the Right Navigation Button. You cannot scroll backwards.

3. Do one of the following:
   - Press the **Secure Button** (Programmable, Top Left Button) to stop the displays and toggle between RF test mode and the Control Top and Keypad test mode. The test mode menu "`CH test`" is displayed, indicating that you have selected the Control Top and Keypad test mode. Go to Section "5.2.4 CH Test Mode (Control Top and Keypad Test)" on page 5-5.

     NOTE: Each press of the **Secure Button** will toggle between "`RF test`", "`CH test`", either "`RGB test`" or "`CID test`" (only if the flip is in close position after powerup) and "`Vibration test`."

   - Press the **Emergency Button** (Programmable, Top Right Orange Button) to stop the displays and put the radio into the RF test mode. The test mode menu, "`1 CSQ`", is displayed, indicating test frequency 1, Carrier SQuelch mode. Go to Section "5.2.3 RF Test Mode" below.

     NOTE: Once your radio is in a particular test mode, you must turn off the radio and turn it back on again to access the other test mode.

5.2.3 RF Test Mode

When the ASTRO XTS 4000 radio is operating in its normal environment, the radio's microcomputer controls the RF channel selection, transmitter key-up, and receiver muting, according to the customer codeplug configuration. However, when the unit is on the bench for testing, alignment, or repair, it must be removed from its normal environment using a special routine, called **RF TEST MODE**.

While in RF test mode:

- Each additional press of **Side Button** advances to the next test channel. (Refer to Table 5–3.)
- Pressing **Programmable Keypad Bottom** scrolls through and accesses the test environments shown in Table 5–4.

NOTE: Transmit into a load when keying a radio under test.

Table 5–3. Test Frequencies (MHz)

Test Channel	VHF RX	VHF TX	UHF RX	UHF TX
F1	136.075	136.025	380.075	380.025
F2	142.075	142.125	395.075	395.025
F3	154.275	154.225	409.950	409.9
F4	160.175	160.125	424.9	424.85
F5	168.125	168.075	438.2	438.150
F6	173.925	173.975	444.1	444.05
F7	–	–	456.4	456.350
F8	–	–	463.750	463.7
F9	–	–	469.7	469.650

Table 5–4. Test Environments

Display	Description	Function
CSQ	Carrier Squelch	RX: unsquelch if carrier detected TX: mic audio
TPL	Tone Private-Line	RX: unsquelch if carrier and tone (192.8 Hz) detected TX: mic audio + tone (192.8 Hz)
AST	ASTRO	RX: none TX: 1200 Hz tone *
USQ	Carrier Unsquelch	RX: unsquelch always TX: mic audio

* All deviation values are based on deviation tuning of this mode.

5.2.4 CH Test Mode (Control Top and Keypad Test)

This test mode is used to verify proper operation of all radio buttons and switches if a failure is suspected.

5.2.4.1 Control Top Checks

To perform the control top checks:

1. Press and hold the **Emergency Button** (Programmable, Top Right Orange Button); the radio icons are displayed.

   NOTE: Not all radio icons are shown. To check LCD display, perform either RGB or CID Test Mode. (Refer "5.2.5 RGB Test Mode (Only applicable to Internal Display)" on page 5-6 / "5.2.6 CID Test Mode (Only applicable to External Display)" on page 5-7.)

2. Release the **Emergency Button**; "3/0" appears, which indicates that the **Emergency Button** is in the open position. Your radio is now in the Control Top and Keypad test mode.
3. Press the **Emergency Button** again; "3/1" appears, which indicates that the **Emergency Button** is in the closed position.
4. Press the **Upper Volume Rocker**; "80/1" appears; release "80/0" appears.
5. Press the **Lower Volume Rocker**; "81/1" appears; release "81/0" appears.
6. Press the **Secure Button** (Programmable, Top Left Button); "96/1" appears; release, "96/0" appears.
7. Press **Programmable Keypad Button**; "97/1" appears; release, "97/0" appears.
8. Press **Side Button**; "98/1" appears; release, "98/0" appears.
9. Press the **PTT Button**; "1/1" appears; release, "1/0" appears.

5.2.4.2 Keypad Checks:

To continue to the keypad checks:

- Press **0**, "48/1" appears; release, "48/0" appears.
- Press **1**, "49/1" appears; release, "49/0" appears.
- Press **2**, "50/1" appears; release, "50/0" appears.
- Press **3**, "51/1" appears; release, "51/0" appears.
- Press **4**, "52/1" appears; release, "52/0" appears.
- Press **5**, "53/1" appears; release, "53/0" appears.
- Press **6**, "54/1" appears; release, "54/0" appears.
- Press **7**, "55/1" appears; release, "55/0" appears.
- Press **8**, "56/1" appears; release, "56/0" appears.
- Press **9**, "57/1" appears; release, "57/0" appears.
- Press *****, "58/1" appears; release, "58/0" appears.
- Press **#**, "59/1" appears; release, "59/0" appears.
- Press **Left Navigation Button**, "128/1" appears; release, "128/0" appears.
- Press **Right Navigation Button**, "130/1" appears; release, "130/0" appears.
- Press **Up Navigation Button**, "135/1" appears; release, "135/0" appears.
- Press **Down Navigation Button**, "136/1" appears; release, "136/0" appears.
- Press **Left Menu Select Button**, "131/1" appears; release, "131/0" appears.
- Press **Middle Menu Select Button**, "132/1" appears; release, "132/0" appears.
- Press **Right Menu Select Button** "133/1" appears; release, "133/0" appears.
- Press **Home Button**, "129/1" appears; release, "129/0" appears.
- Press **Data Button**, "134/1" appears; release, "134/0" appears.

5.2.5 RGB Test Mode (Only applicable to Internal Display)

To perform the RGB Color Test:

1. Press and release the **Emergency Button** (Top Right Orange button); "4 Border test" appears.
2. Press any key; Crosstalk test patterns appears.
3. Press any key; White color test appears.
4. Press any key; Red color horizontal lines appears.
5. Press any key until all 13 red color horizontal lines appears.
6. Press any key; Green color vertical line appears.
7. Press any key until all 13 green color vertical lines appears.
8. Press any key; Black color test appears.
9. Press any key; Blue color test appears.
10. Press any key; "Test completed" appears.

5.2.6 CID Test Mode (Only applicable to External Display)

To perform the CID Test:

1. Press and release the **Emergency Button** (Top Right Orange button); all pixels are on.
2. Press any key; Checker box 1 test appears.
3. Press any key; Checker box 2 test appears.
4. Press any key; "`Test completed`" appears.

5.2.7 Vibration Test Mode

To perform the Vibration Test:

1. Press and release the **Emergency Button** (Top Right Orange button); "`Press any key to proceed`" appears.
2. Press any key (except the Power Button); the radio produce the vibration.

5.3 Receiver Performance Checks

CAUTION: Remove any accessory connected to the audio jack before making audio measurement thru the CE port. The audio level is attenuated when both the CE port and audio jack are connected.

The following table outline the performance checks for the receiver.

*Table 5–5. Receiver Tests for ASTRO Conventional Channels**

Test Name	System Analyzer	Radio	Test Set	Comments
Bit Error rate (BER) Floor	**Mode:** Proj 25 Std **RF Control:** Gen **Output Level:** -47 dBm **Proj 25 Dev:** 2.83 kHz **Code:** 1011 Hz PAT	Radio Tuner Software (Bit Error Rate screen) is required	**PTT** to OFF (center)	BER < 0.01% (Use test setup shown in Figure 5–1, on page 5-1)
Reference Sensitivity	As above; lower the output level until 5% BER is obtained	As above	As above	Output level < 0.35 µV (-116 dBm) (Use test setup shown in Figure 5–1, on page 5-1)
Audio Output Distortion	**Mode:** Proj 25 Std **RF Control:** Gen **Output Level:** -47 dBm **Proj 25 Dev:** 2.83 kHz **Code:** 1011 Hz PAT **Meter:** Ext. Distortion	Radio Tuner Software not used; **Radio:** Out of TEST MODE; Select a conventional ASTRO channel	**PTT** to OFF (center) Meter selector to **Audio PA** Spkr/Load to **Speaker**	Distortion < 3.0%
Residual Audio Noise Ratio	**Mode:** Proj 25 Std **RF Control:** Gen **Output Level:** -47 dBm **Proj 25 Dev:** 2.83 kHz **Code**: A) 1011 Hz PAT B) Silence PAT **Meter:** AC Volts	As above	As above	Residual Audio Noise Ratio -45 dB

Table 5–5. Receiver Tests for ASTRO Conventional Channels (Continued)*

Test Name	System Analyzer	Radio	Test Set	Comments

* *These tests require a communications system analyzer with the ASTRO 25 test options.*

5.4 Transmitter Performance Checks

The following table outline the performance checks for the transmitter.

*Table 5–6. Transmitter Tests for ASTRO Conventional Channels**

Test Name	System Analyzer	Radio	Test Set	Comments
RF Power	**Mode:** Proj 25 Std **RF Control:** Monitor **Meter:** RF Display	Radio Tuner Software not used. **Radio:** Out of TEST MODE; Select a conventional ASTRO channel	**PTT** to continuous (during measurement).	**VHF:** 1–2 Watts **UHF1:** 0.25–2 Watts
Frequency Error	As above	As above	As above	Error ≤ ±1.0 kHz
Frequency Deviation	As above	Radio Tuner Software (Transmitter Test Pattern screen) is required) **High use:** Symbol Rate PAT **Low use:** Low Symbol Rate P	**PTT** to OFF (center)	D_{HIGH} ≥ 2.543 kHz but ≤ 3.110 kHz D_{LOW} ≥ 0.841 kHz but ≤ 1.037 kHz (Use test setup shown in Figure 5–1, on page 5-1

* *These tests require a communications system analyzer with the ASTRO 25 test options.*

Notes

Chapter 6 Radio Alignment Procedures

This chapter describes both receiver and transmitter radio alignment procedures.

6.1 Test Setup

A personal computer (PC) and tuner software are required to align the radio. Refer to the applicable manual for installation and setup procedures for the software. To perform the alignment procedures, the radio must be connected to the PC and to a universal test set. The radio alignment test setup is shown in Figure 6-1.

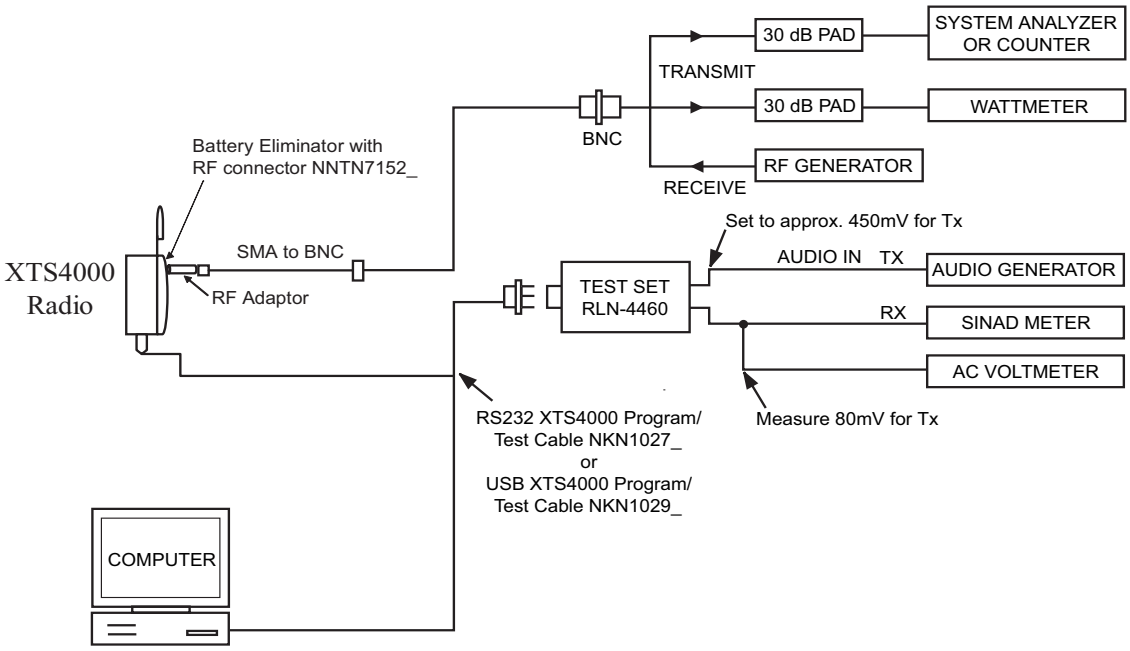


Figure 6-1. Radio Alignment Test Setup

> **Caution**
>
> These radio alignment procedures should only be attempted by qualified service personnel. Failure to perform alignment procedures properly may result in seriously degraded radio or system performance.

6.2 Tuner Main Menu

Select **Tuner** from the **START** menu. To read the radio, use the F**ile › Read Device** menu or click on . Figure 6–2 illustrates how the alignment screens are organized. To access a screen, double-click on the desired screen name in the **Tuner** menu.

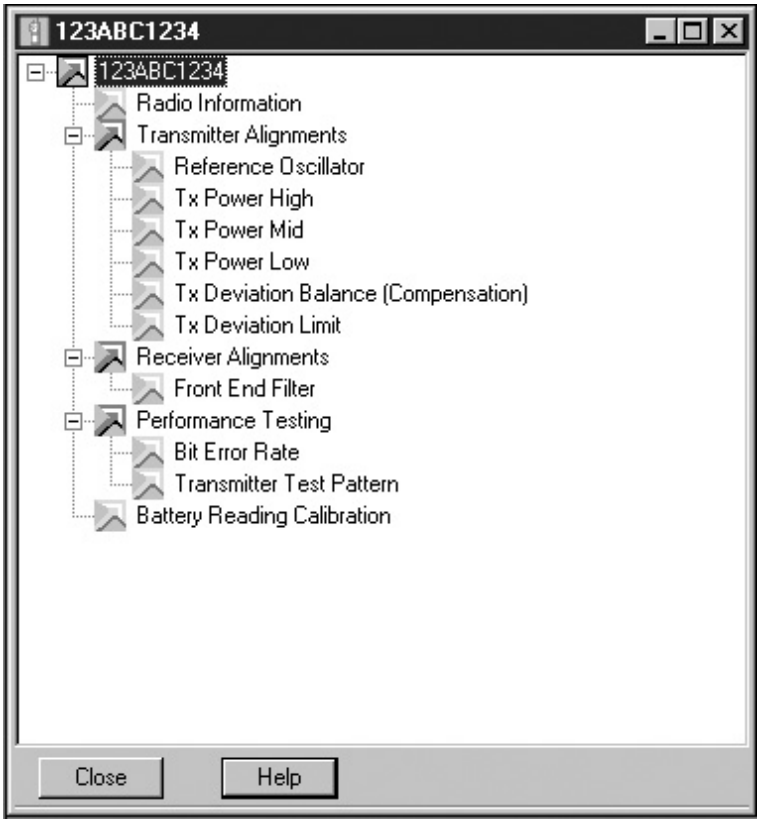


Figure 6–2. Tuner Software Main Menu

6.3 Softpot

The alignment screens introduce the concept of the “softpot,” an analog **SOFT**ware-controlled **POT**entiometer used for adjusting all transceiver alignment controls.

> Caution
>
> DO NOT switch radios in the middle of any alignment procedure. Always left-click the **Close** button on the screen to return to the Main Menu screen before disconnecting the radio. Improper exits from the alignment screens might leave the radio in an improperly configured state and result in seriously degraded radio or system performance.

Each alignment screen provides the ability to increase or decrease the softpot value by using a slider or the spin buttons in the New Softpot Value box, or by entering the new value from the keyboard directly into the box. The slider bar indicates the minimum and maximum values of the softpot, while the Radio Softpot Value indicates the recommended value; see Figure 6–3 (VHF)/ Figure 6–4 (UHF).

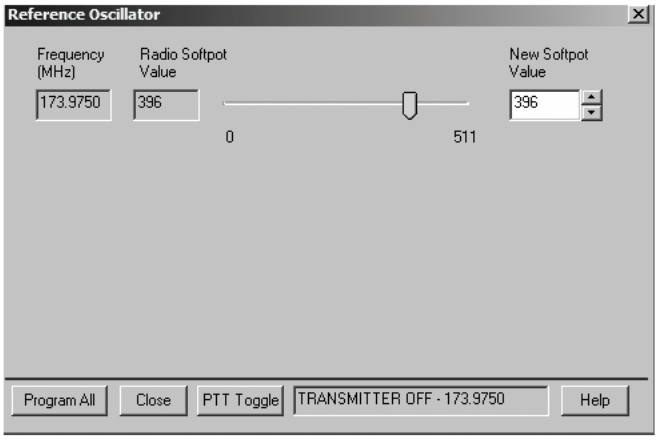


Figure 6–3. Typical Softpot Screen – VHF

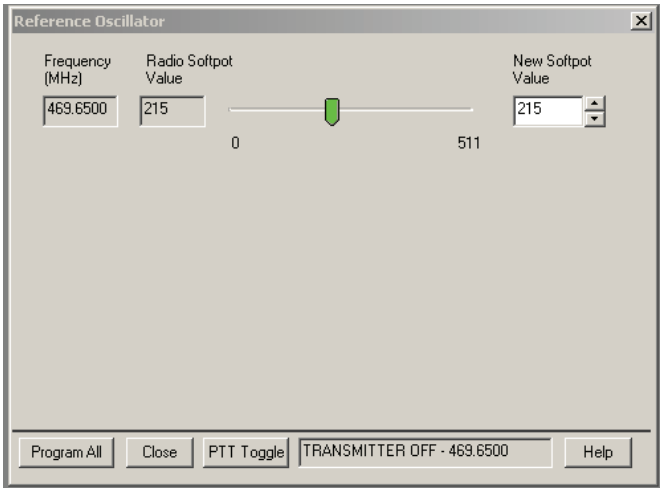


Figure 6–4. Typical Softpot Screen – UHF

Adjusting the softpot value sends information to the radio to increase (or decrease) the voltage in the corresponding circuit. For example, left-clicking the UP spin button in the New Softpot Value scroll box on the **Reference Oscillator** screen instructs the radio's microcomputer to increase the voltage across a varactor in the reference oscillator, which increases the frequency.

In ALL cases, the softpot value is just a relative number corresponding to a digital-to-analog (D/A) generated voltage in the radio.

Perform the following procedures in the sequence indicated.

NOTE: Some of the following screens may vary depending upon the radio under test and the version of tuner software you are using. Refer to the software's online help.

Caution

When keying the radio during a test, always transmit into a dummy load.

6.4 Radio Information

Figure 6–5 shows a typical Radio Information screen. This screen is informational only and cannot be directly changed.

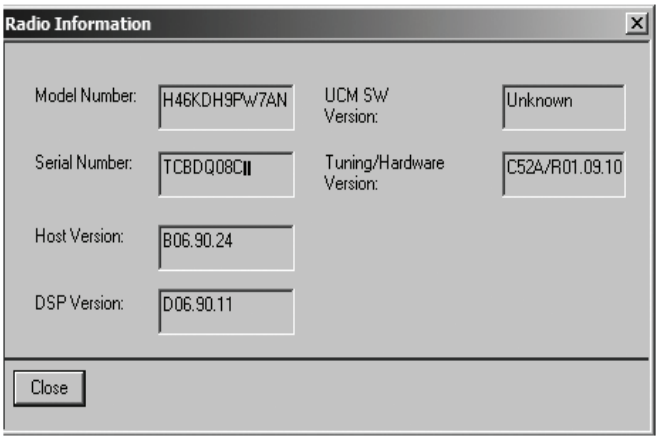


Figure 6–5. Radio Information Screen

6.5 Reference Oscillator Alignment

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will result not only in poor operation, but also in a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced, or once a year, whichever comes first. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better).

NOTE: Reference oscillator alignment is required after replacing (or servicing) the mainboard.

This test can be done with either the R-2670 Communication Analyzer or the 8901_ Modulation Analyzer.

- Initial setup using the R-2670 Communication Analyzer:
  - RF Control: MONITOR
  - B/W: WB
  - Freq: CPS frequency under test
  - Attenuation: 20dB
  - Mon RF in: RF I/O
  - Meter: RF Display
  - Mode: STD
  - Input Level: uV or W
  - Display: Bar Graphs
  - Squelch: Mid-range or adjust as necessary
- Initial setup using the 8901_ Series Modulation Analyzer:
  - Press the green **Automatic Operation** button on the analyzer.
  - Press the **FREQ** key.
  - Type **7.1** followed by **SPCL** button to set the 8901B_ modulation analyzer for maximum accuracy.

To align the reference oscillator:

1. Select the **Reference Oscillator** alignment screen. See Figure 6–6 (VHF) below/ Figure 6–7 (UHF) on page 6-6.

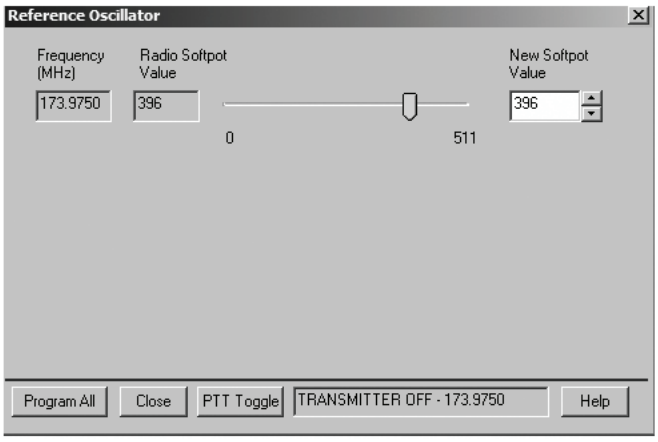


Figure 6–6. Reference Oscillator Alignment Screen – VHF

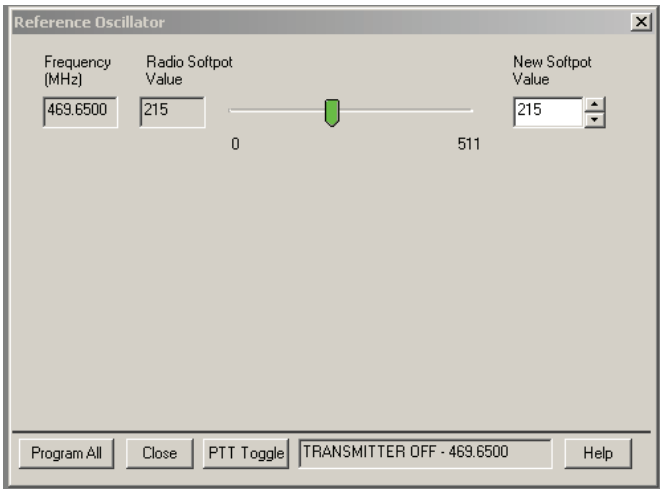


Figure 6–7. Reference Oscillator Alignment Screen – UHF

2. Click the **PTT Toggle** button to make the radio transmit. The screen indicates whether the radio is transmitting.
3. Measure the transmit RF frequency with your service monitor.
4. Adjust the reference oscillator's softpot value until the measured value is as close as possible to the frequency shown on the screen. See Table 6–1.

Table 6–1. Reference Oscillator Alignment

Band	Target
VHF	±100 Hz
UHF	±100 Hz

5. Click the **Program All** button to save the tuned values in the radio.
6. Click the **Close** button to return to the **Transmitter Alignments** menu.

6.6 Transmit Power Alignment

This alignment procedure adjusts the transmit power of the radio and must be performed for three different power levels (Low, Mid, and High), at multiple frequencies for each power level, to allow for proper alignment across the entire RF band. The RF band is divided into frequency zones with a calibration point (value) in each zone.

NOTES:

- The same softpot attenuation value will result in **different** radio output power levels at different frequencies.
- All power measurements are to be made at the antenna port.
- Transmit Power alignment is required after replacing (or servicing) the mainboard.

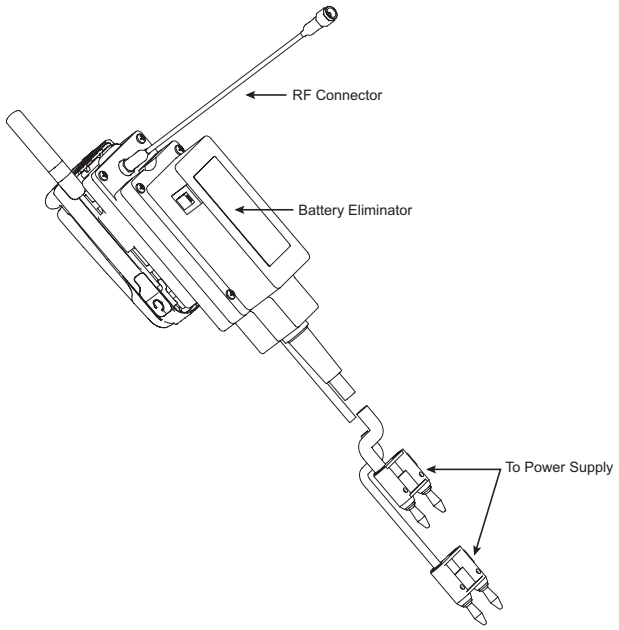


Figure 6–8. Battery Eliminator with RF Connector and SMA

To align transmit power:

1. Select the **TX Power (Low, Mid,** or **High)** alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 6–9 (VHF)/ Figure 6–10 (UHF) on page 6-8.
2. Click the desired frequency field (starting with the highest frequency shown).
3. Click the **PTT Toggle** button to make the radio transmit. The screen indicates whether the radio is transmitting.
4. Measure the transmit power of the radio with a service monitor.
5. Adjust the softpot value until the required power, as shown in Table 6–2, is indicated on the service monitor.

Table 6–2. Transmit Power Settings

Power Level	Transmit Power (Watts)	Transmit Power (Watts)
	VHF	UHF
Low	1.2–1.4	0.2–0.3
High	2.2–2.4	2.2–2.4

6. Repeat Steps 2 through 5 for all frequencies and all power levels.
7. Click the **Program All** button to save the tuned values in the radio.
8. Click the **Close** button to return to the **Transmitter Alignments** menu.

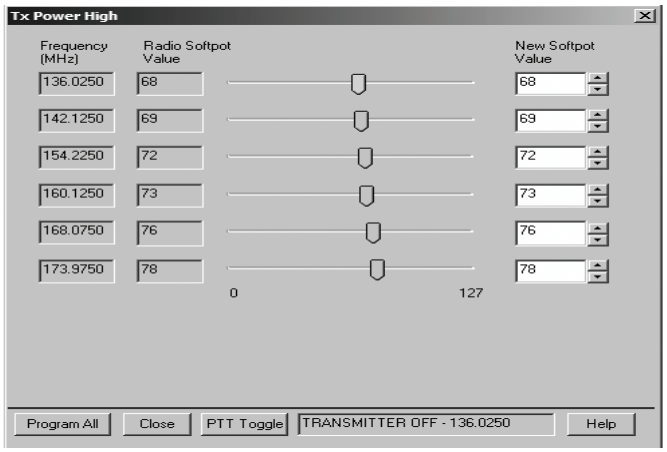


Figure 6–9. Transmit Power Alignment Screen (Typical) – VHF

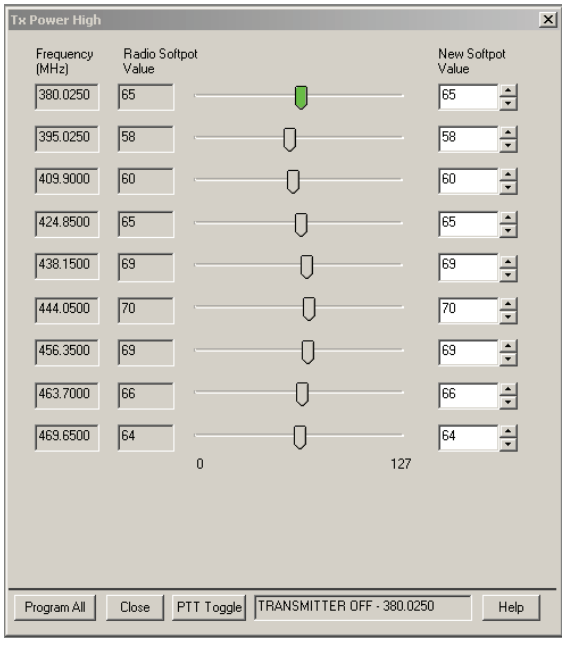


Figure 6–10. Transmit Power Alignment Screen (Typical) – UHF

6.7 Transmit Deviation Balance Alignment

This alignment procedure balances the modulation contributions of the low- and high-frequency portions of a baseband signal. Proper alignment is critical to the operation of signalling schemes that have very low frequency components (for example, DPL) and could result in distorted waveforms if improperly adjusted.

This procedure needs to be performed at multiple frequencies to allow for proper alignment across the entire RF band. The RF band is divided into frequency zones with a calibration point (value) in each zone.

NOTE: This alignment is required after replacing (or servicing) the main board.

Proper alignment requires a modulation analyzer or meter with a frequency response to less than 10 Hz modulating frequency. The modulation analyzer settings during this test should be set for average deviation, a 15 kHz low-pass filter, no de-emphasis, and no high-pass filter, if these settings are supported.

This test can be done with either the R-2670 Communication Analyzer or the 8901_ Series Modulation Analyzer. The method of choice is the R-2670 analyzer.

1. Initial setup using the R-2670 Communication Analyzer:
   – Connect a BNC cable between the “DEMOD OUT” port and the “VERT/SINAD DIST/DMM COUNTER IN” port on the R-2670.
   – Press the **SPF** key on the R-2670 to display the “SPECIAL FUNCTIONS MENU.” Move the cursor to “High Pass,” and select 5 Hz on the soft key menu. Select 20 kHz for the “Low Pass” setting.
   – In the “RF Control” section of the R-2670, enter the frequency displayed on the RSS screen. Move the cursor to the “B/W” setting and select “WIDE +/- 100 kHz” on the soft key menu.
   – Place the R-2670 cursor in the “Display” zone. Select “AC VOLTS” on the soft key menu. Move the cursor to the “Range” setting and select “AUTO.”
2. Initial setup using the 8901_ Series Modulation Analyzer:
   – Press the **FM MEASUREMENT** button. (The “*Error 03-input level too low”* indication is normal until an input signal is applied.)
   – Simultaneously press the **Peak –** and **Peak +** buttons. Both LEDs on the buttons should light.
   – Press the 15 kHz LP filter key.
3. Select the **TX Deviation Balance** alignment screen. The screen indicates the transmit frequencies to be used. See Figure 6–11 (VHF)/ Figure 6–12 (UHF) on page 6-10.
4. Click the desired frequency field (starting with the highest frequency shown).
5. Click the **PTT Toggle** button to make the radio transmit. The screen indicates whether the radio is transmitting.

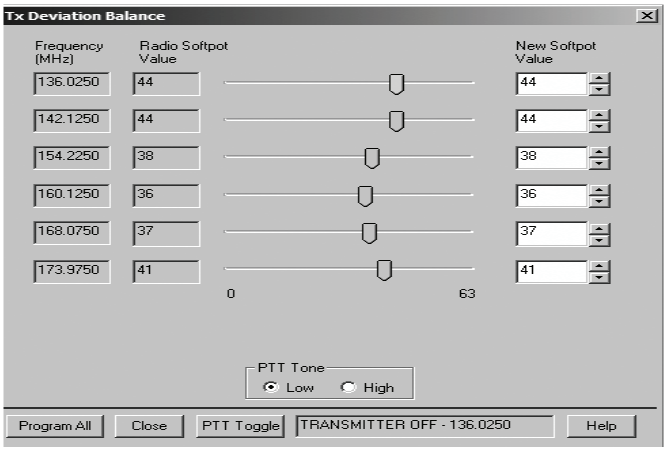


Figure 6–11. Transmit Deviation Balance Alignment Screen – VHF

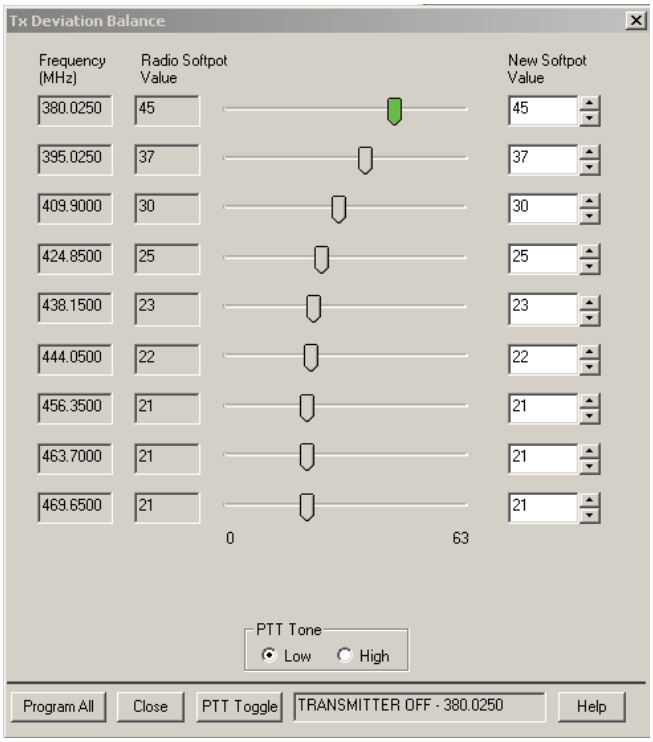


Figure 6–12. Transmit Deviation Balance Alignment Screen – UHF

6. Click the **PTT Tone: Low** button.
7. Click the **PTT Toggle** button on the screen to enable transmission. The screen indicates whether the radio is transmitting. Wait approximately 5 seconds until the voltage shown on R-2670, or the deviation shown on the 8901_ analyzer, stabilizes.
8. Measure and record the ac voltage value from the R-2670 analyzer or the deviation value from the 8901_ series analyzer.
9. Left-click the **PTT Tone: High** button.

10. Adjust the softpot value until the measured deviation/voltage, when using the high tone, is within +/- 1.5% of the value observed when using the low tone.
11. Repeat the above process for all frequencies.
12. Click the **Program All** button to save the tuned values in the radio.
13. Click the **Close** button to return to the **Transmitter Alignments** menu.

6.8 Transmit Deviation Limit Alignment

This alignment procedure limits the modulation of a baseband signal. It is used for primary modulation limiting.

This procedure needs to be performed at multiple frequencies to allow for proper alignment across the entire RF band. The RF band is divided into frequency zones with a calibration point (value) in each zone.

NOTE: This alignment is required after replacing (or servicing) the main board.

This test can be done with either the R-2670 Communication Analyzer or the 8901_ Series Modulation Analyzer. The method of choice is the R-2670 analyzer.

1. Initial setup using the R-2670 Communication Analyzer:
   – Connect a BNC cable between the “DEMOD OUT” port and the “VERT/SINAD DIST/DMM COUNTER IN” port on the R-2670.
   – Press the **SPF** key on the R-2670 to display the “SPECIAL FUNCTIONS MENU.” Move the cursor to “High Pass,” and select 5 Hz on the soft key menu. Select 20 kHz for the “Low Pass” setting.
   – In the “RF Control” section of the R-2670, enter the frequency displayed on the RSS screen. Move the cursor to the “B/W” setting and select “WIDE +/- 100 kHz” on the soft key menu.
   – Place the R-2670 cursor in the “Display” zone. Select “AC VOLTS” on the soft key menu. Move the cursor to the “Range” setting and select “AUTO.”
2. Initial setup using the 8901_ Series Modulation Analyzer:
   – Press the **FM MEASUREMENT** button. (The “*Error 03-input level too low”* indication is normal until an input signal is applied.)
   – Simultaneously press the **Peak –** and **Peak +** buttons. Both LEDs on the buttons should light.
   – Press the 15 kHz LP filter key.

3. Select the **TX Deviation Limit** alignment screen. The screen will indicate the transmit frequencies to be used. See Figure 6–13 (VHF)/ Figure 6–14 (UHF) on page 6-12.

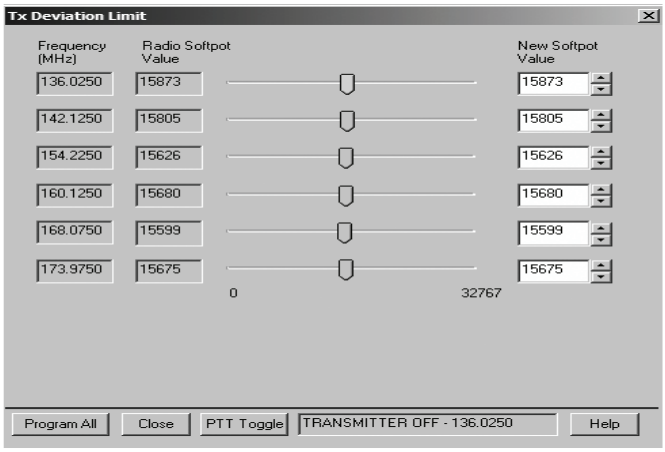


Figure 6–13. Transmit Deviation Limit Alignment Screen – VHF

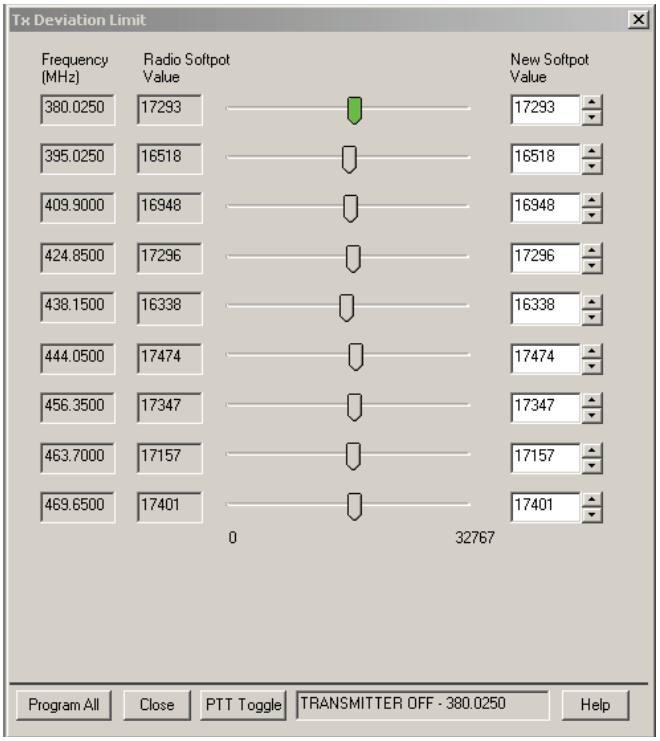


Figure 6–14. Transmit Deviation Limit Alignment Screen – UHF

4. Click the desired frequency field (starting with the highest frequency shown).
5. Click the **PTT Toggle** button to make the radio transmit. Wait approximately 5 seconds until the deviation/voltage displayed on the analyzer stabilizes. The screen indicates whether the radio is transmitting.
6. Adjust softpot value until the measured deviation is as close as possible to 2.83 kHz.
7. Repeat the above process for all frequencies.

8. Click the **Program All** button to save the tuned values in the radio.
9. Click the **Close** button to return to the **Transmitter Alignments** menu.

6.9 Front End Filter Alignment

> Caution
>
> This procedure should only be attempted by qualified service technicians.

This alignment procedure adjusts the front end receiver bandpass filters for the best receiver sensitivity and selectivity. This procedure should be performed for all test frequencies to allow for proper software interpolation of frequencies between the test frequencies in the band (see Figure 6–16 (VHF) below/ Figure 6–17(UHF) on page 6-14).

NOTE: Rx Front End Filter Alignment is required after replacing (or servicing) the mainboard.

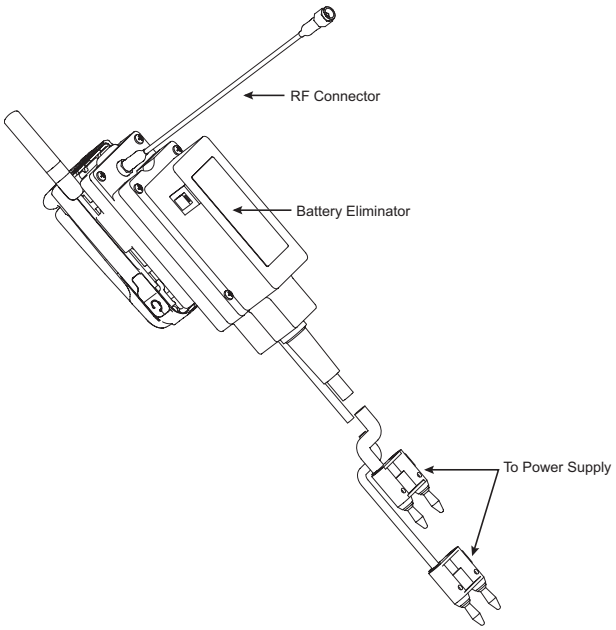


Figure 6–15. Battery Eliminator with RF Connector and SMA

6.9.1 Procedure for VHF/ UHF

To align the VHF/ UHF receiver front end:

1. Click the desired frequency field.
2. Apply an RF signal with no modulation at -90 dBm on the current operating frequency.
3. Start with a softpot value (approximately 10 or 20), increase softpot in ascending order, and note the RSSI values. The RSSI will reach a peak value and remain stable and then decrease. Allow the limits of the peak range to be defined as RSSI PEAK - 3. Choose the middle of the peak range and program the corresponding softpot value as the tuned softpot value.

4. Repeat the above process for all frequencies.
5. Click the **Program All** button to save the tuned values in the radio.

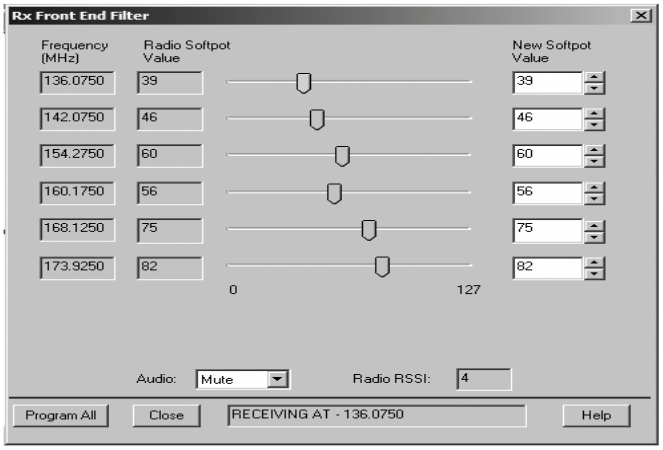


Figure 6–16. Front End Filter Alignment Screen – VHF

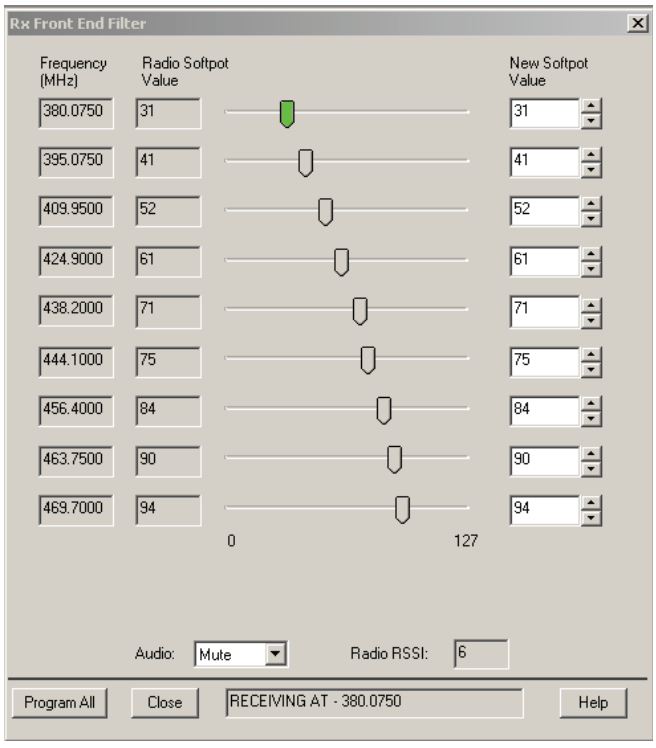


Figure 6–17. Front End Filter Alignment Screen – UHF

6.10 Bit Error Rate

This section describes the Bit Error Rate (BER) test of the radio's receiver at a desired frequency (see Figure 6–18, on page 6-16).

6.10.1 Bit Error Rate Fields

Set up the R2670 Communication Analyzer as follows:

1. Connect the RF Input port of the radio under test to the RF IN/OUT port of the R2670 Service Monitor.
2. Set up the R2670 Service Monitor:
   – In the Display Zone, select PROJ 25 STD mode and set the meter to RF DISPLAY.
   – In the RF Zone, configure the analyzer as follows:

RF Control:	Generate
Preset:	B/W: NB
Freq:	Test frequency (Ex: 136.075 MHz/ 380.075 MHz)
Output Level:	-50.0 dBm
Gen RF Out:	RF I/O

   – In the Audio Zone, select the 1011 Hz PAT code and set the deviation to "PROJ25Dev: 2.83 kHz ~".

The bit error rate screen contains the following fields:

- **Rx Frequency**:
  This field selects the Receive Frequency directly in MHz.
- **Test Pattern**:
  This field selects the Digital test pattern — TIA. Choices are: Standard Tone Test Pattern (Framed 1011) and Standard Interface Test Pattern (CCITT V.52).
- **Modulation Type**:
  This field represents the digital modulation type of the incoming signal on which BER is to be calculated.
- **Continuous Operation**:
  This field allows the user the option to repeat the BER test indefinitely. A selection of Yes will cause the radio to calculate BER on a continuous basis and update the results on this screen after each integration time. A selection of No will cause the BER test to execute for only one sample of the integration time and then update the display.
- **Audio**:
  This field allows the user to select the audio output during a test. Selecting Internal will cause the radio's built-in speaker to unmute to any signals at the desired frequency which are present during the test. Selecting External will route the same signal to the radio's accessory connector audio output. Selecting Mute will disable the audio output.
- **BER Integration Time**:
  This field represents the amount of time over which the Bit Error Rate is to be calculated. The range is from 0.360 to 91.8 seconds in increments of 0.360 seconds.

NOTE: When **Continuous Operation = Yes**, all fields will be grayed out while the test is in progress. They will be enabled when the STOP button is pressed.

When **Continuous Operation = No**, a wait cursor will be displayed while the test is in progress and return to normal when the test is done.

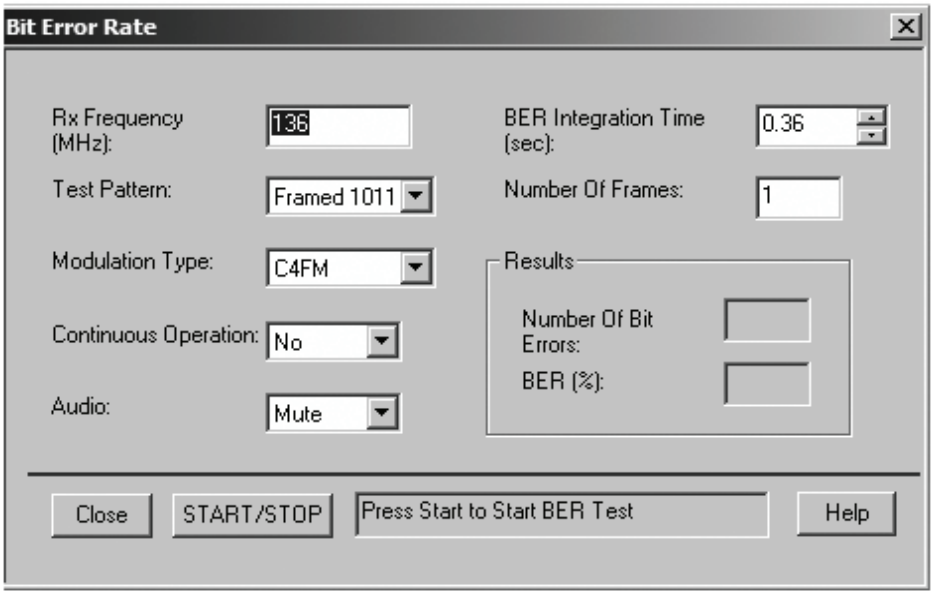


Figure 6–18. Bit Error Rate Screen

6.11 Transmitter Test Pattern

The Transmitter Test Pattern test is used to transmit specific test patterns at a desired frequency so that the user can perform tests on the radio's transmitter (see Figure 6–19 below/ Figure 6–20 on page 6-17).

6.11.1 Transmitter Test Fields

This screen contains the following fields:

- **Tx Frequency**:
  This field selects the Transmit Frequency directly in MHz.
- **Channel Spacing**:
  This field allows the user to select the desired transmit deviation in kHz.
- **Test Pattern Type**:
  This field represents the type of test pattern which will be transmitted by the radio when **PTT TOGGLE** button is pressed.

NOTE: Channel Spacing and Test Pattern Type fields will be grayed out while radio is transmitting.

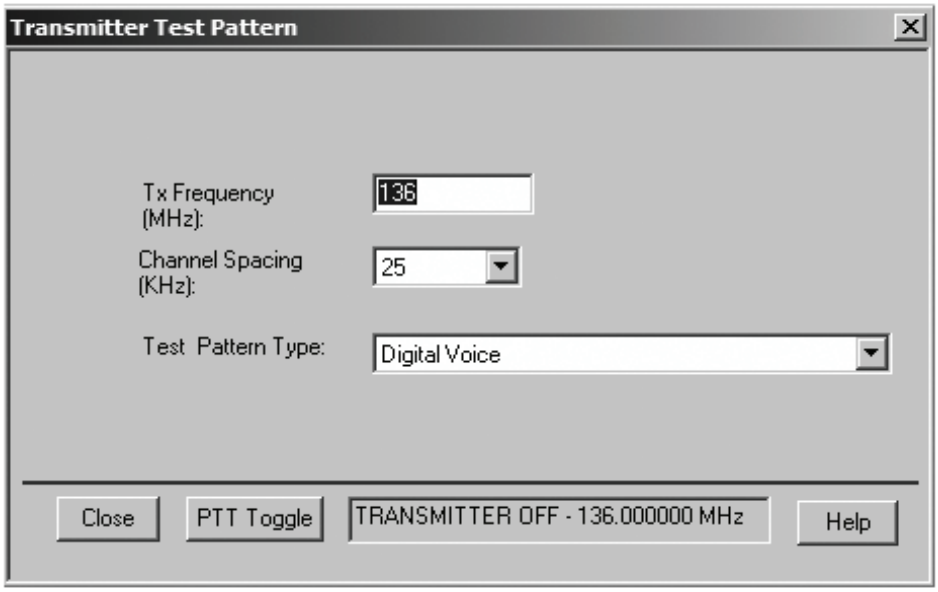


Figure 6–19. Transmitter Test Pattern Screen – VHF

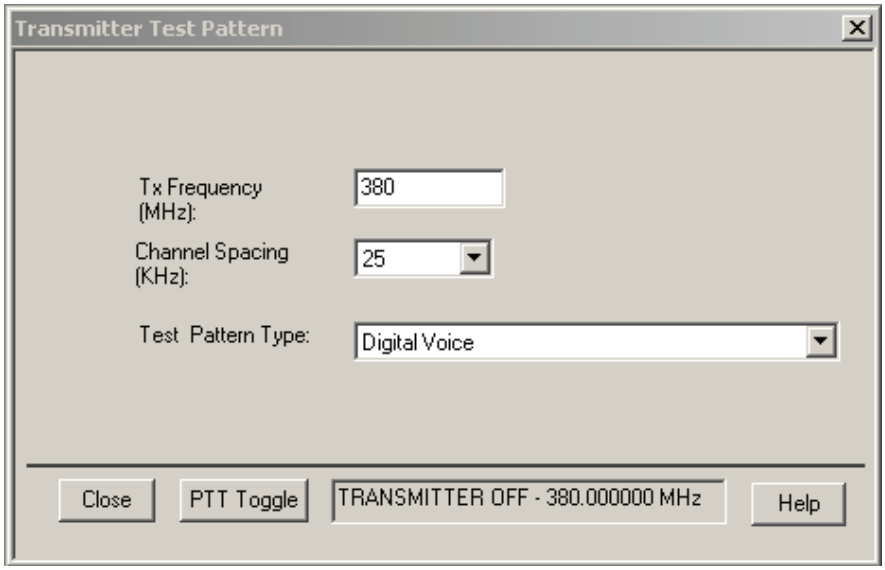


Figure 6–20. Transmitter Test Pattern Screen – UHF

Notes

Chapter 7 Encryption

This chapter provides procedures for using the encryption capability of your radio. The following procedures are outlined:

- Loading an encryption key
- Selecting an encryption key
- Selecting an Index
- Erasing an encryption key

7.1 Load an Encryption Key

To load an encryption key:

1. Refer to the key-variable loader (KVL) manual for equipment connections and setup.
2. Attach KVL to the bottom connector of the radio using Keyload cable 0182297T15. The display shows "KEYLOADING." All other radio functions, except for power down, backlight, and volume, are locked out.
3. Refer to the KVL manual for how to load the encryption keys into the radio.
4. When the key is loaded successfully, you will hear:
   - On single-key radios – a short tone.
   - On multikey radios – an alternating tone.

7.2 Multikey Feature

This feature allows the radio to be equipped with multiple encryption keys. It can support up to two different encryption algorithms simultaneously (e.g., DVP-XL and DES-XL).

- **Conventional Multikey** – The encryption keys can be tied (strapped), on a one-per-channel basis. In addition, the radio can have operator-selectable keys, operator-selectable indices, and operator-selectable key erasure. If talkgroups are enabled in conventional, then the encryption keys are strapped to the talkgroups.
- **Trunked Multikey** – If the radio is used for both conventional and trunked applications, strap the encryption keys for trunking on a per- talkgroup or announcement group basis. In addition, a different key can be strapped to other features; for example, dynamic regrouping, failsoft, or emergency talkgroup. The radio can have operator-selectable key erasure.

7.3 Select an Encryption Key

You can select an encryption key using either the menu or the keypad.

7.3.1 Use the Menu

To select an encryption key using the menu:

1. Press **Right Navigation Button** until the display shows "KEY."
2. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button**, directly below "KEY." The display shows the last user-selected and stored encryption key, as well as the available menu selections.

3. Press **Left Navigation Button** or **Right Navigation Button** to scroll through the list of encryption keys.

   NOTE: If you select an erased key, the display alternates between showing the encryption key and "ERASED KEY."

4. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below the desired menu.
   - PSET = selects the preset or default encryption key.
   - SEL = saves the newly selected key and returns to the home display.
5. Press **Home Button**, the **PTT Button**, or **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below the ABRT menu to exit this menu.
   - If the selected key is erased, the display shows "KEY FAIL" and the radio sounds a momentary keyfail tone.
   - If the selected key is not allowed, the display shows "ILLEGAL KEY" and the radio sounds a momentary illegal key tone.

7.3.2 Use the Keypad

To select an encryption key using the keypad:

1. Press **Right Navigation Button** until the display shows "KEY."
2. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below "KEY." The display shows the last user-selected and -stored encryption key, as well as the available menu selections.
3. Using the keypad, enter the number of the desired key.

   NOTE: If you select an erased key, the display alternates between showing the encryption key and "ERASED KEY."

4. Press **Left Navigation Button** or **Right Navigation Button** to select from the menu.
   - PSET = selects the preset or default encryption key.
   - SEL = saves the newly selected key and returns to the home display.
5. Press h, the **PTT Button**, or **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below the ABRT menu.
   - If the selected key is erased, the display shows "KEY FAIL" and the radio sounds a momentary keyfail tone.
   - If the selected key is not allowed, the display shows "ILLEGAL KEY" and the radio sounds a momentary illegal key tone.

7.4 Select an Encryption Index

This feature lets the user select one or more groups of several encryption keys from among the available keys stored in the radio. For example, the radio could have a group of three keys structured to one index, and another group of three different keys structured to another index. Changing indices makes the radio automatically switch from one set of keys to the other. Every channel to which one of the original keys was tied will now have the equivalent new key instead.

7.4.1 Use the Menu

To select an index using the menu:

1. Press **Right Navigation Button** until the display shows "INDX."
2. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below "INDX." The display shows the last user-selected and stored index, as well as the available index menu selections.
3. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below the desired index. The display shows the last user- selected and -stored index, as well as the available index menu selections.
4. Choose one of the following:
   a. To save the index, press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below "SEL."
   b. To exit this menu without changing the index selection, press **Home Button** or the **PTT Button**.

7.4.2 Use the Keypad

To select an index using the keypad:

1. Press **Right Navigation Button** until the display shows "INDX."
2. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below "INDX." The display shows the last user-selected and -stored index, as well as the available index menu selections.
3. Using the keypad, enter the number of the desired index.
4. Choose one of the following:
   a. To save the index, press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below "SEL."
   b. To exit this menu without changing the index selection, press **Home Button** or the **PTT Button**.

7.5 Erase an Encryption Key

This section describes two methods for erasing an encryption key.

7.5.1 Method 1 – Key Zeroization (Multikey Only)

To zeroize an encryption key:

1. Press **Right Navigation Button** until the display shows "ERAS."
2. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below "ERAS." The display shows the last user-selected and -stored encryption key, as well as the available menu selections that are listed in Table 7–1.
3. Choose one of the following:
   - If you want to erase all the encryption keys at once, go to section 7.5.2: "Method 2 – All Keys Erased" on page 7-4 below.
   - If you want to erase a single encryption key, do one of the following:
     – Press **Left Navigation Button** or **Right Navigation Button** to find the desired key. The display shows the selected key and the available menu selections shown in Table 7–1.

– Using the keypad, enter the location number of the desired key. The display shows the selected key, as well as the available menu selections shown in Table 7–1.

Table 7–1. Encryption Key Zeroization Options

Menu Selection	Action
ALL	Erases all the encryption keys in the radio. The display shows "ERS ALL KEYS" and "YES" and "NO."
SNGL	Selects the displayed encryption key to be erased.The display shows "ERS SNGL KEY" and "YES" and "NO."
ABRT	Exits this menu and returns to the home display

NOTE: To exit this menu at any time without erasing the key selection, press **Home Button** or the **PTT Button**.

4. Press **Left Menu Select Button**, **Middle Menu Select Button**, or **Right Menu Select Button** directly below the desired menu selection.
5. Press **Home Button** or the **PTT Button** to exit this menu.

7.5.2 Method 2 – All Keys Erased

To erase all encryption keys at one time:

With the radio on, press and hold the **Secure Button (Programmable, Top Left Button)** and, while holding this button down, press the **Emergency Button (Programmable, Top Right Orange Button)**.

NOTE: **DO NOT** press the **Emergency Button (Programmable, Top Right Orange Button)** before pressing the **Secure Button (Programmable, Top Left Button)** unless you are in an emergency situation. This sends an emergency alarm.

Before the keys are erased, the display shows "PLEASE WAIT."

When all the encryption keys have been erased, the display shows "ALL KEYS ERASED."

Chapter 8 Disassembly/Reassembly Procedures

This chapter provides detailed procedures for disassembling/reassembling XTS 4000 radios. When performing these procedures, refer to “Chapter 10: Exploded Views and Parts Lists” on page 10-1 and the diagrams that accompany the text. Items in parentheses ( ) throughout this chapter refer to item numbers in the exploded view diagrams and their associated parts lists.

8.1 XTS 4000 Exploded View (Partial)

This section contains the XTS 4000 radio partially exploded view and parts list.

NOTES:

- Refer to Figure 8–1 on page 8-2, the Partial Exploded View, and Table 8–1 on page 8-2, the Corresponding Exploded View and Parts List.
- Numbers in parentheses ( ) refer to item numbers in Figure 8–1 and Table 8–1 on page 8-2.
- The Battery Assembly (E) and Antenna Assembly (D) should be removed from the radio before disassembly or reassembly the radio.

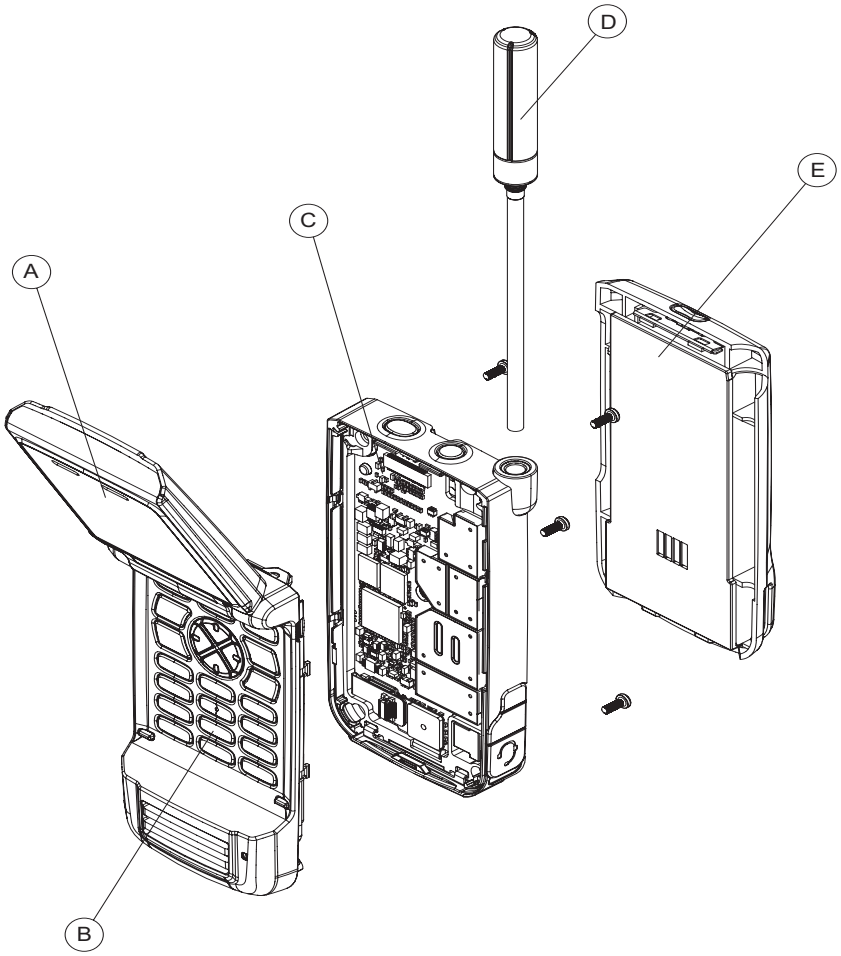


Figure 8–1. XTS 4000 Partial Exploded View

Table 8–1. Corresponding XTS 4000 Exploded View and Parts List

Item Number	Description	Exploded View and Parts List
A	Flip Assembly	Refer “10.2 Exploded View and Parts List – Flip-Front Housing Assemblies” on page 10-3.
B	Front Housing Assembly	Refer “10.2 Exploded View and Parts List – Flip-Front Housing Assemblies” on page 10-3.
C	Chassis Assembly	Refer “10.3 Exploded View and Parts List – Chassis Assembly” on page 10-4.
D	Antenna Assembly	Refer “10.1 Exploded View and Parts List – Main Assemblies” on page 10-2.
E	Battery Assembly	Refer “10.1 Exploded View and Parts List – Main Assemblies” on page 10-2.

8.2 Required Tools and Supplies

Table 8–2. Required Tools and Supplies

Tools and Supplies	Motorola Part Number	Supplier	Supplier Part Number
Anti-static ground kit	0180386A82		
Magnetic screwdriver set with bits	0180320B16		
Tape, Top and Side Controls Assembly Aid	1171742L01		
Black Stick	–	Hexacon Electric Co.	MA-800G
Analog Torque Driver (1-6 in-lbs)		Tohnichi	6RTD-A
T3IP, T6IP, and T7IP Torx bits	–		
Audio Jack Assembly Tool	6671241M01		
Tweezers	–		

8.3 Fastener Torque Chart

Table 8–3 lists the various fasteners by part number and description, followed by the torque values and the location where used. Torque all fasteners to the recommended value when assembling the radio.

Table 8–3. Fastener Torque Chart

Motorola Part Number	Description	Repair Torque (in-lbf)
0371903L01	Flip Assembly Screw (5)	1.5
0371907L01	Antenna Bushing Screw (43) Keypad Backer Screw (18)	2.1 3.1
0371711L01	Battery Connector Screw (45)	1.1
0371904L01	Chassis Screw (49)	4.4

8.4 Antenna

This section explains how to attach and remove the antenna.

8.4.1 Attach the Antenna

To attach the antenna:

With the radio turned off, turn the antenna clockwise to attach it to the radio.

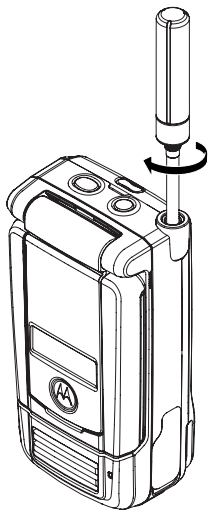


Figure 8–2. Attaching the Antenna

8.4.2 Remove the Antenna

To remove the antenna:

With the radio turned off, turn the antenna counter-clockwise to remove it from the radio.

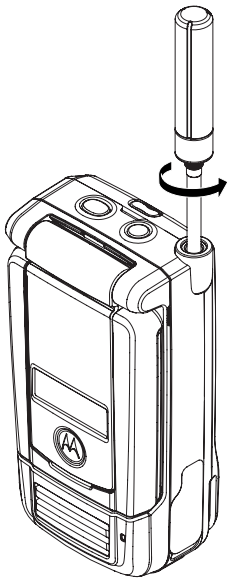


Figure 8–3. Removing the Antenna

8.5 Battery

This section explains how to properly attach and remove the battery.

WARNING

To avoid a possible explosion:
- **DO NOT charge, remove, or attach the battery in an area labeled "hazardous atmosphere."**
- **DO NOT discard batteries in a fire.**

Caution

If the radio is programmed for volatile-key retention, encryption keys will be retained for approximately 30 seconds after battery removal.

NOTE: The Motorola-approved battery shipped with the XTS 4000 radio is uncharged. Prior to using a new battery, charge it for a minimum of 16 hours to ensure optimum capacity and performance.

8.5.1 Attach the Battery

To attach the battery:

1. With the radio turned off, insert the bottom edge of the battery into the slot at the back of the Main Chassis as shown.

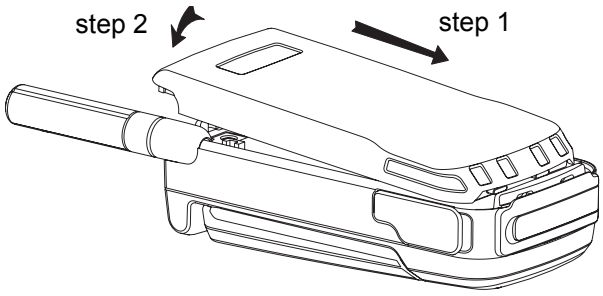


Figure 8–4. Attaching the Battery

NOTE: Do not attach the battery without engaging the bottom tabs to prevent damage to the battery or the radio

2. Rotate the battery toward the radio and press down until the battery clicks into place.

8.5.2 Remove the Battery

To remove the battery:

1. With the radio turned off, press the release button on the top of the battery until the battery releases from the radio.

2. Rotate and remove the battery from the radio.

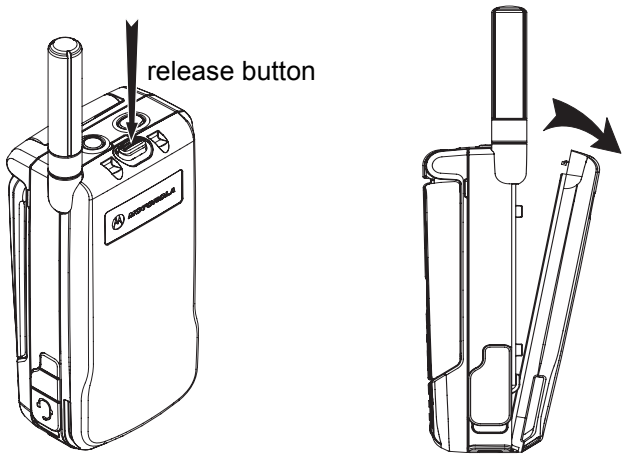


Figure 8–5. Removing the Battery

8.6 Radio Disassembly

This section contains instructions for disassembling the radio. For this section, please refer to “10.1 Exploded View and Parts List – Main Assemblies” on page 10-2,“10.2 Exploded View and Parts List – Flip-Front Housing Assemblies” on page 10-3 and “10.3 Exploded View and Parts List – Chassis Assembly” on page 10-4.

IMPORTANT: When servicing radio parts* listed in Chapter 10, complete section 8.6.1 followed by the steps of the proper section depending on the location of the specific components location.

To service components in Chassis Assembly (C), refer section 8.6.2 "Disassemble the Chassis Assembly". †

To service components in Front housing Assembly (B), refer section 8.6.3 "Disassemble the Front Housing Assembly".†

To service components in Flip assembly (A), separate the flip assembly from Front Housing Assembly (B) by completing steps 1 to10 but skip steps 7-8 in section 8.6.3, then refer section 8.6.4 "Disassemble the Flip Assembly". †

* Exceptions: CID Bezel (1), Battery Ground redundant Contact (44), Battery Connector Screw (45), 5Ohm RF Dust Cap Seal (46), Port Seal (47), Audio Jack PC Label (48) and Chassis Screw (49).

† Completion of ALL the steps in each section is NOT necessary depending on the component to be serviced.

For example: to service the main board, after completing all steps in section 8.6.1, continue step 1-4 in section 8.6.3 to have access till main board level, after that complete the reassemble steps per describe in their respective section in Radio Reassembly.

8.6.1 Separate the Flip-Front Housing and Chassis Assemblies

To separate the Flip-Front Housing Assembly (A+B) from the Chassis Assembly (C):

1. Turn off the radio by holding down the **Power Button** for 3 seconds.
2. Remove the Antenna Assembly (D), Battery Assembly (E) or any accessory connected to the radio.
3. Remove the 5 chassis screws (49) from the back of the radio with a Torx T7 bit driver.
4. Insert the Black Stick (refer "8.2 Required Tools and Supplies" on page 8-3 for part number). into the groove between the Front Housing and the Control Band (20) near the top (opposite of **PTT** area). Gently tilt to separate the Flip-Front Housing Assembly from the Chassis Assembly.

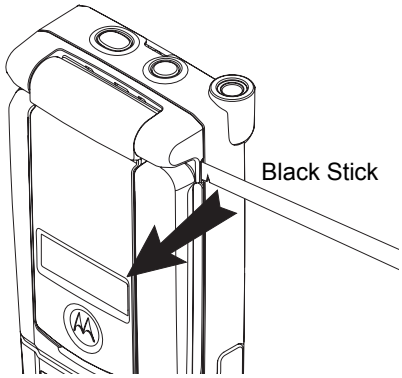


Figure 8–6. Separating Flip-Front Housing Assembly From Chassis Assembly

5. Lay both sub-assemblies (A+B and C) side by side on the anti-static mat (part of anti-static ground kit. Refer "8.2 Required Tools and Supplies" on page 8-3 for part number). Gently unplug the Keypad Backer Inner Jumper Flex (17) from the Main Board (29). Also gently unplug the CE-UCM Connector Flex (28) from the XTS4000 UCM Board (10) located at the bottom of the Front Housing Assembly (B) as shown in Figure 8–7.

> **Caution** When separating the flexes and small interconnects, care is needed to avoid damage to the interconnect and surrounding on-board components.

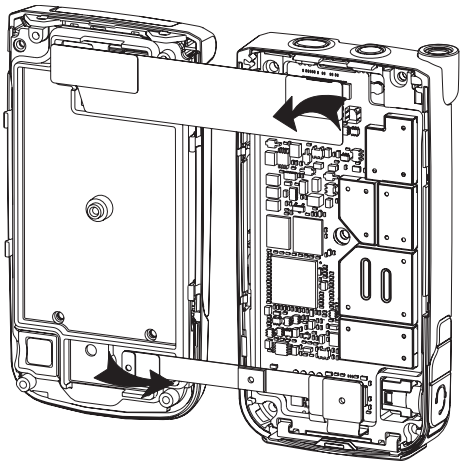


Figure 8–7. Unplugging Flexes

8.6.2 Disassemble the Chassis Assembly

To disassemble the chassis (C):

1. Gently disconnect the CE-UCM Connector Flex (28) from the Main Board (29).

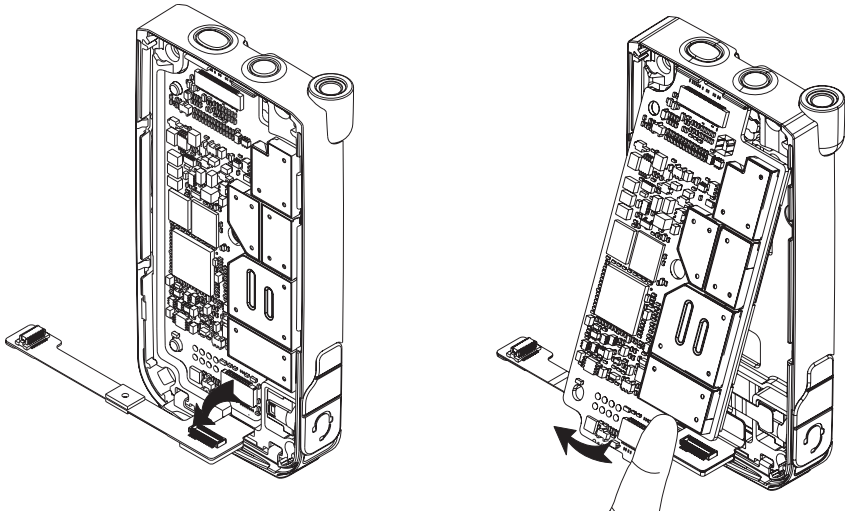


Figure 8–8. Disconnecting CE-UCM Connector Flex and Lifting Main Board

2. Lift up the Main Board (29) from the bottom of the Main Chassis (39) and rotate 90° towards the chassis top side.

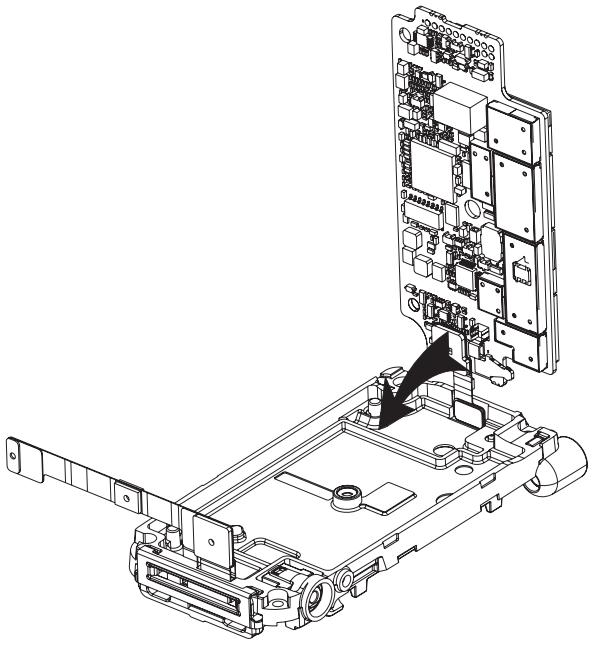


Figure 8–9. Rotating Main Board 90° and Unplugging Top Control Inner Jumper Flex

3. Unplug the Top Control Inner Jumper Flex (33) from the top of the Main Board (29).
4. Remove the Main Board (29) and lay it aside. The B Plus Seal (31) may be removed from the B Plus Connector on the back of the Main Board (29).
5. Use the tweezers to remove the center Screw Seal (32) from the Main Chassis (39).
6. Flip open the Audio Jack Dust Cover (22) and the CE Connector Dust Cover (21) from the Control Band (20).

Caution	Removing the Control Band (20) from the Main Chassis (39) without disengaging the dust covers may damage the Control Band.

Caution	When removing the control band, make sure the Side and Top Control Flex (40) and the metal dome array mylar is not damage during the disassembly.

7. Hold the chassis with the back facing up; push down the Control Band (20) on the **PTT** side so that the latches are unlocked from the Main Chassis (39). Gently pull the Control Band side outwards to disengage the Control Band. Rotate the Control Band anti-clockwise along the antenna axis to remove it totally from the Main Chassis (39).

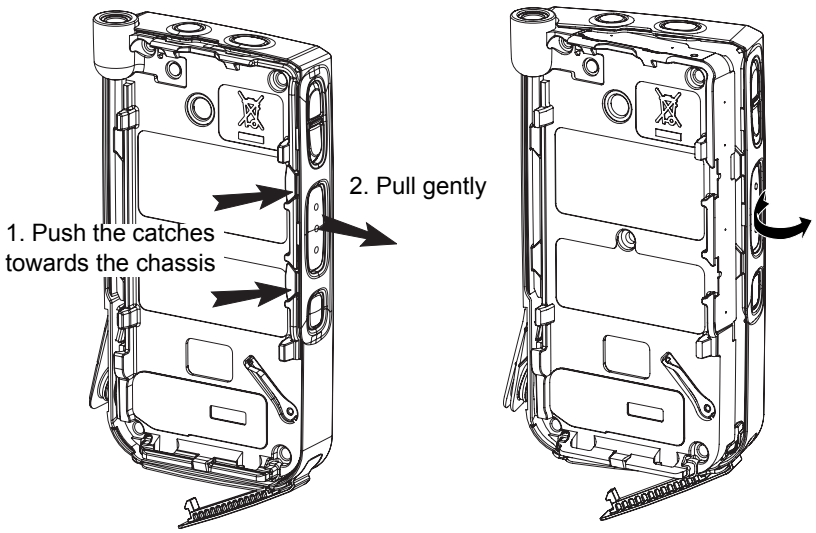


Figure 8–10. Removing Control Band

8. Separate the Top and Side Controls Buttons (23+24) from the Control Band (20).
9. Rotate the tab behind the Audio Jack Dust Cover (22) 90°. Pull the Audio Jack Dust Cover tab out from the Control Band (20) opening as shown in Figure 8–11. Push the tab behind the CE Connector Dust Cover (21) down. Rotate the tab 90° and pull the dust cover out from the Control Band as shown in Figure 8–12.

.

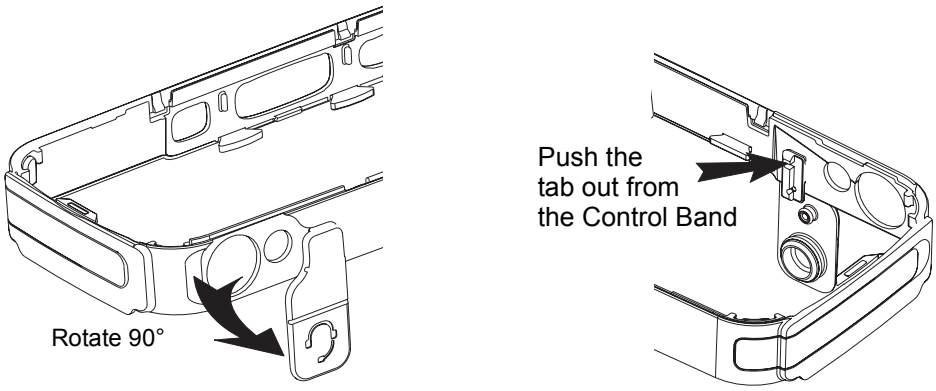


Figure 8–11. Removing Audio Jack Dust Cover

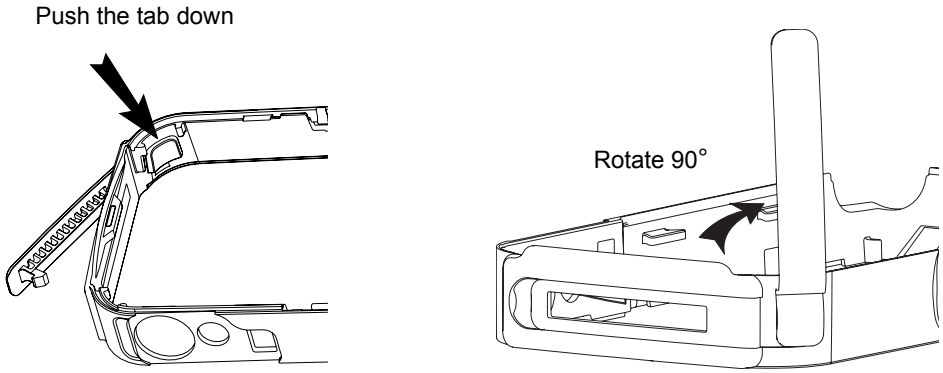


Figure 8–12. Removing CE Dust Cover

10. Gently disengage the snap on Audio Jack Insulator (38). Place the tip of the tweezers at bottom of Insulator ring. With one hand, push the Insulator tab through the chassis hole while simultaneously pressing down and pulling out the Insulator ring with the tweezers. Using the tweezers, grip the sides of the Audio Jack Alignment Sleeve (25) and pull straight out to remove.

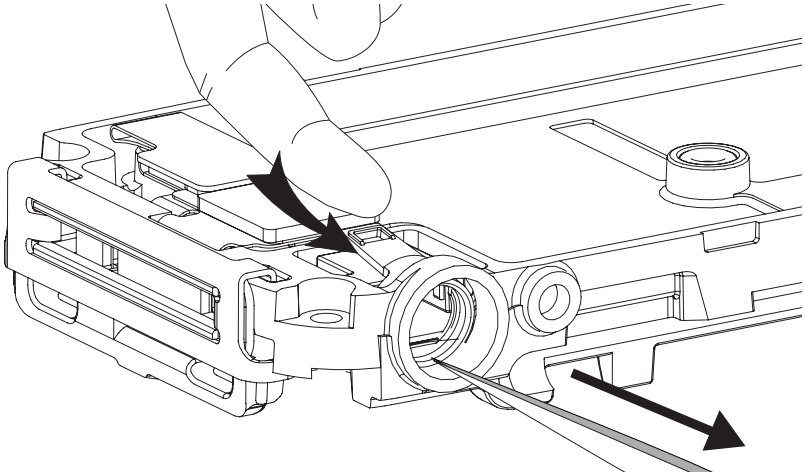


Figure 8–13. Removing Audio Jack

11. Use a tweezer to peel off the Audio Jack PC Label (48) and the Gore Membrane (47) from the back of the Main Chassis (39).
12. Unplug the CE-UCM Connector Flex (28) from the Audio Jack Board (26) and push the Audio Jack Board out from the Main Chassis (39) with the help of the Black Stick.
13. Unplug the female connector on the Top Control Inner Jumper Flex (33) from the Side and Top Control Flex (40). Peel off the Side and Top Control Flex (40) from the Main Chassis (39).

    NOTE: Once the Side and Top Control Flex (40) is removed, replaced it with a new one. Locate them accordingly to the top control locator pin on then the side control locating features on the casting.

14. Unplug the female connector of the CE-UCM Connector Flex (28) from the CE Connector Board (36) at the bottom of the Main Chassis (39) to remove the CE-UCM Connector Flex.
15. To remove the Bottom CE Retainer (34) from the Main Chassis (39), push the CE Retainer towards the front side of the Main Chassis direction until it stops. Then remove it together with the CE Spacer (35) by directing it away from the bottom of the casting (refer Figure 8–14). Use the tweezers to peel off the CE Connector Board (36) as shown in Figure 8–15.

> Caution
>
> Avoid inserting the tweezers into the connector area of the CE Connector Board (36).

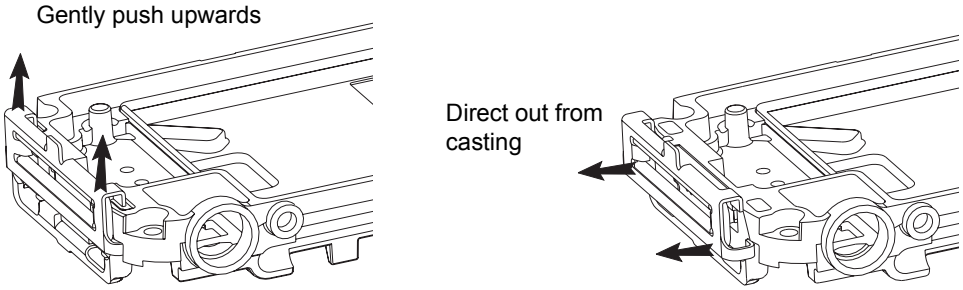


Figure 8–14. Removing CE Retainer and Spacer

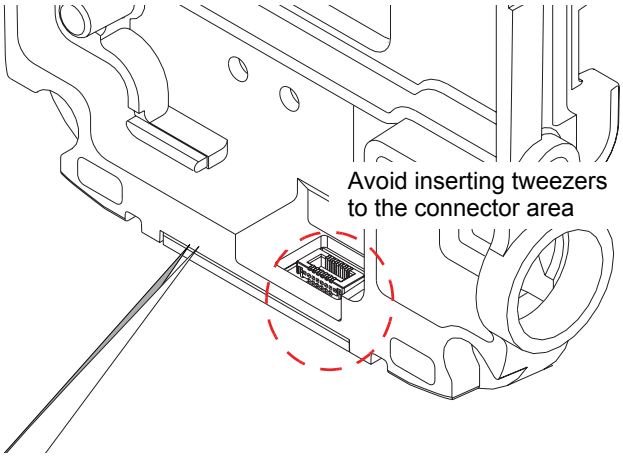


Figure 8–15. Removing CE Board

16. Loosen the top screw (43) on the Antenna Bushing Assembly (42) with a Torx T6 bit torque driver and remove the Antenna Bushing Assembly.
17. Remove the Battery Connector Screw (45) with a Torx T3 bit torque driver and separate the Battery Ground Redundant Contact (44).

8.6.3 Disassemble the Front Housing Assembly

To disassemble the Front Housing Assembly (B):

1. Remove the Main Seal (19) from the Keypad Backer Sub-Assembly (15).
2. Remove the 4 screws from the Keypad Backer Sub-Assembly with a Torx T6 bit.
3. Remove the Keypad Backer Sub-Assembly by gently tilting the bottom part of the backer out from the Front Housing, then tongue out from the top of the Front Housing.

> Caution
>
> Do not twist or pull the Flip Flex as this might cause permanent damage to the Flip Flex.

> Caution
>
> Steps 4-6 (Speaker Compartment Seal (13), Main Keypad (12), and UCM Module) should be performed while supporting the keypad backer in the orientation shown in Figure 8–16.

4. Remove the Speaker Compartment Seal (13) from the Keypad Backer Sub-Assembly (15).
5. Remove the Main Keypad (12) from the Front Housing. Gently separate the connection between the Speaker Flex and the UCM Board (10) and remove the UCM Board.
6. Carefully separate the Flip Flex (2) from the Keypad Backer Sub-Assembly (15) by gently working the flat head of the Black Stick around the perimeter of the Flip Flex stiffener. Detach the adhesive area of the Flip Flex from the Front Housing.

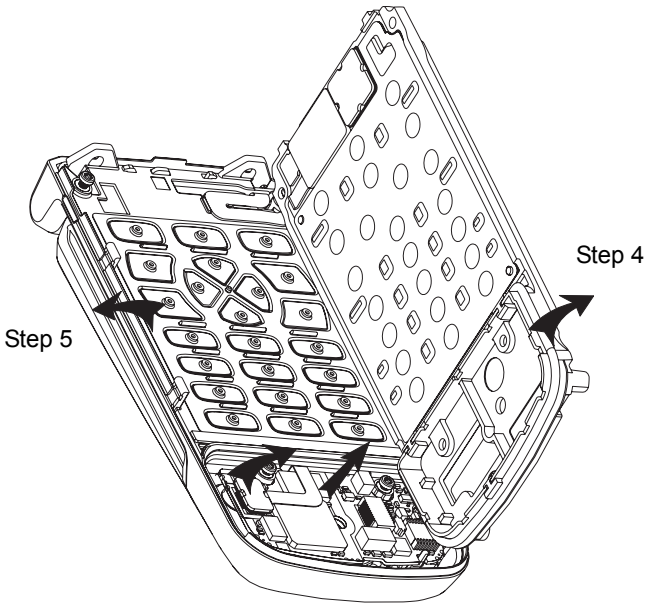


Figure 8–16. Disassemble Speaker Compartment Seal, Main Keyboard and UCM Board

7. Separate the Keypad Backer Inner Jumper Flex (17) from the Keypad Backer Sub-Assembly (15) by gently sliding the flat end of the Black Stick under the flex beginning from the side of the flip fold.

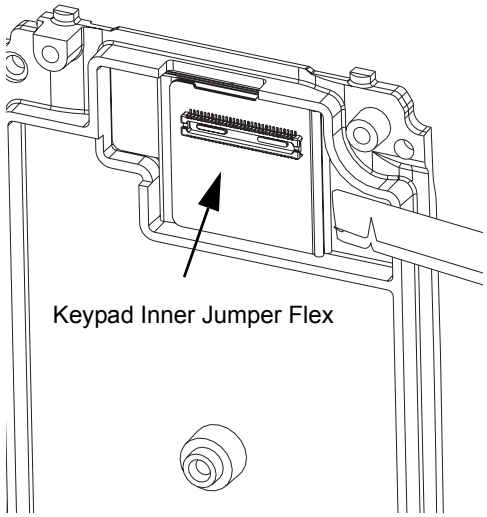


Figure 8–17. Separating Keypad Backer Inner Jumper Flex

NOTE: Once the Keypad Backer Inner Jumper Flex (17) and/or Audio Jack Pad (16) are removed, replaced with new ones. If the Keypad Backer and/or Main Keypad Flex requires servicing, replace with NNTN7100A - Assembly, Keypad Backer.

8. Remove the Audio Jack Pad (16) and Secure Pad (14) as shown in Figure 8–18.

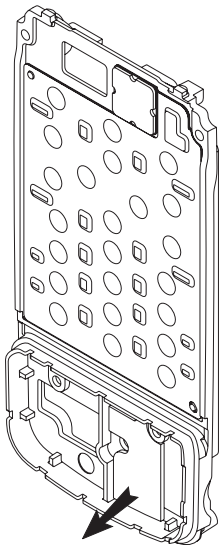


Figure 8–18. Removing Secure Pad

9. With the flip in the open position, insert the flat end of the Black Stick between the flip assembly (A) and the Front Housing. With a corner of the Black Stick positioned as shown in Figure 8–19, gradually increase the gap between the Flip Assembly and Front Housing by twisting the Black Stick until the Flip Assembly separates.

> Caution
>
> Do not twist or pull the Flip Flex as this might cause permanent damage to the Flip Flex.

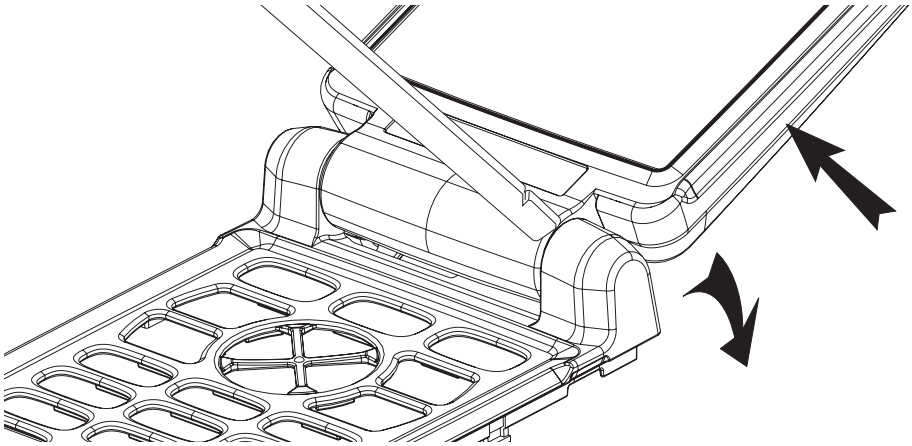


Figure 8–19. Removing Front Housing from Flip Assembly

10. Put the Flip Assembly (A) aside. Remove the Flip Bumper Pad (11) from the Front Housing.
11. Remove each tab of the Flip Stopper Pad (7) as shown in Figure 8–20. Using the flat end of the Black Stick, slide the tab while simultaneously pushing it through the opening in the Front Housing. Then, pull the flip stopper from the side of the front housing to remove the flip stopper.

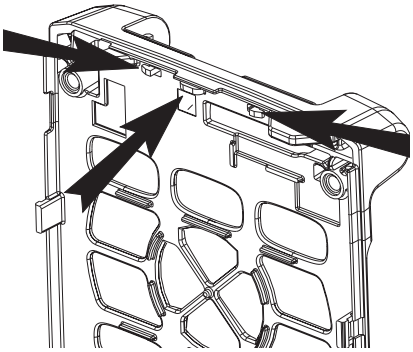


Figure 8–20. Removing Tabs from Flip Stopper Pad

12. Remove the Microphone Boot (8*) and microphone from the Front Housing by gently lifting the Microphone Boot from the side with the flat end of the Black Stick as shown in Figure 8–21. Separate the Microphone Boot from the microphone.

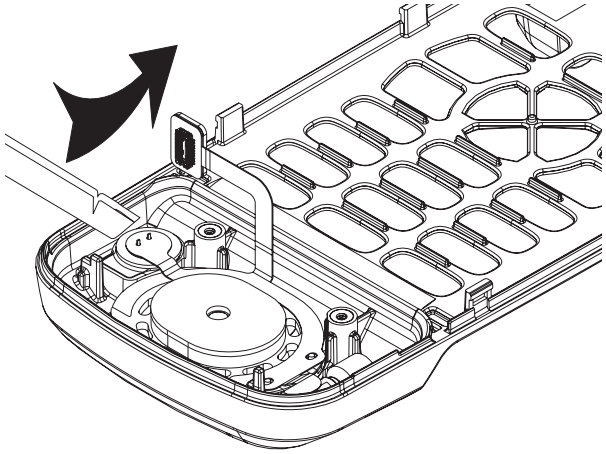


Figure 8–21. Removing Microphone Boot and Microphone from Front Housing

8.6.4 Disassemble the Flip Assembly

To disassemble the flip assembly (A):

1. Slowly insert the Audio Jack Assembly Tool (refer "8.2 Required Tools and Supplies" on page 8-3 for part number) into the Flip Flex opening of the Flip Assembly (A), while positioning the Flip Flex (2) above the tool as shown in Figure 8–22. Lightly push the tool towards the Hinge (4) to separate the hinge from the Flip Assembly.

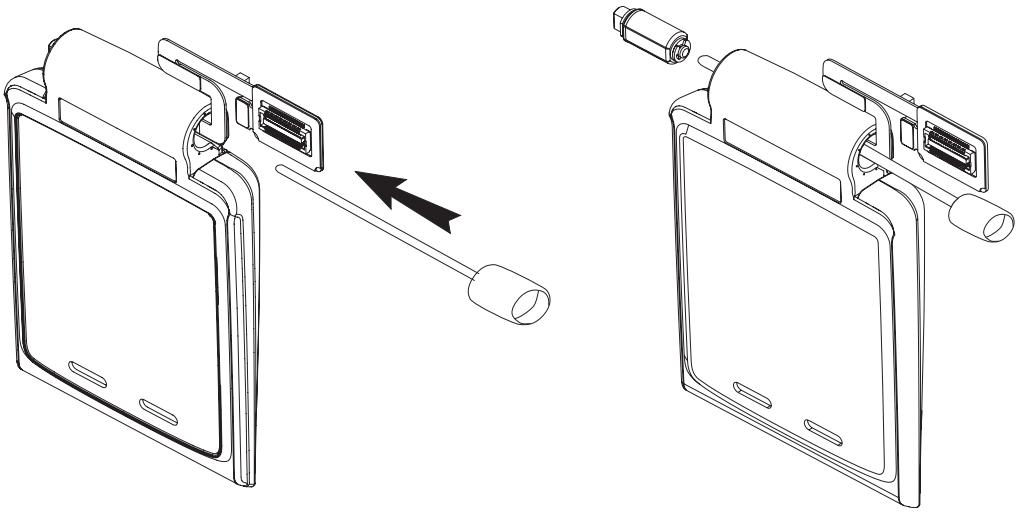


Figure 8–22. Separating Hinge from Flip Inner Housing

2. Peel off the Flip Inner Label (6) from the Flip Sub-Assembly (3) with a tweezers. With the CID Bezel Kit (1) facing down, remove the 2 screws with a Torx T6 bit.

3. Insert the pointed tip of the Black Stick into one of the screw holes to push out the CID Bezel Kit (1).

> Caution
>
> Extreme care must be taken during removal of the CID Bezel Kit (1), particularly near the thin ribs adjacent to the CID Display.

4. Insert the flat part of the Black Stick between the CID Bezel Kit (1) and the Flip Sub-Assembly (3), slowly and gently sweep downwards to release the adhesive of the CID Bezel Kit (1) from the Flip Sub-Assembly.

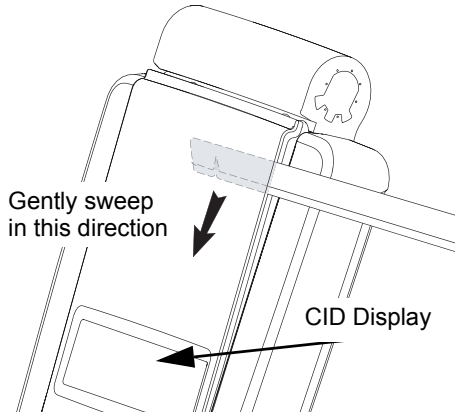


Figure 8–23. Removing CID Bezel

5. Remove the CID Bezel Kit (1) from the tongue in area of the Flip Sub-Assembly (3).
6. Use the flat end of the black stick to remove the adhesive between the Flip Flex (2) and outer flip housing and to unplug the Flip Flex from the Display Module flex connector.

NOTE: The Flip Flex cannot be reused after removed. It must be replaced with a brand new part.

7. Gently pull out the Flip Flex (2) from the hinge compartment of the Flip Sub-Assembly (3).

8.7 Radio Reassembly

This section contains instructions for reassembling the radio.

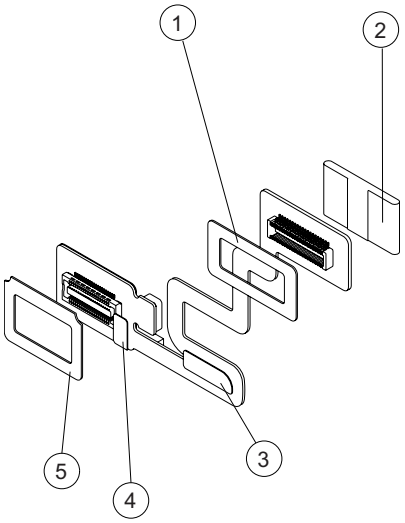
> Caution
>
> All disassembled interfaces requiring adhesive must have new adhesive applied during reassembly. The adhesive surfaces must be clean and free of all foreign material, including oils and/or any remaining adhesive after disassembly. If necessary, the surfaces may be cleaned using a 0.5% solution of a mild dishwashing detergent in water applied sparingly to the surface, ensuring that no water enters into adjacent openings (connectors or otherwise), cracks, or crevices. Remove the solution and dry the surface using a lintless cloth or tissue. All newly applied adhesive interfaces should be press fit for 10 seconds to ensure sealing capability is retained.

8.7.1 Reassemble the Flip Assembly

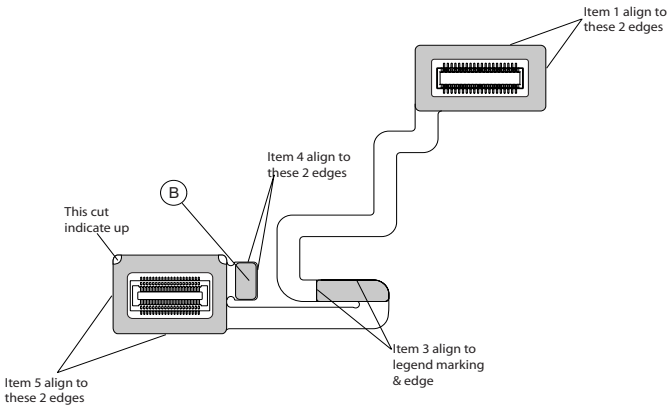
To reassemble the flip assembly (A):

NOTE: Unless the Flip Flex (2) is replaced, otherwise, new adhesives must be applied using material from the Field Service Kit – Adhesive (NNTN7189_) whenever any adhesive is removed from the Flip Flex.

.

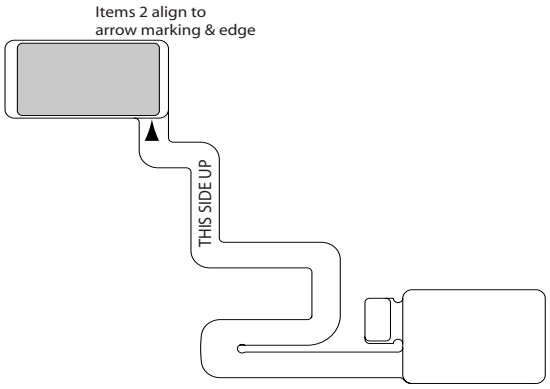


Adhering the Adhesive to Flip Flex – Overview


Item 1 align to these 2 edges
Item 4 align to these 2 edges
B
This cut indicate up
Item 3 align to legend marking & edge
Item 5 align to these 2 edges

Adhesive Location – Front View

Item No.	Motorola Part number	Description
1	1171646L01	Adhesive, Flip Flex Seal 2 (Flip)
2	7571858L01	Pad, Conductive Foam
3	1171845L01	Adhesive, Flip Flex Housing
4	1171857L01	Adhesive, Conductive
5	1171645L01	Adhesive, Flip Flex Seal 1 (Backer)



Adhering the Adhesive to Flip Flex – Overview

Figure 8–24. Flip Flex

1. Prepare adhesives surfaces of the Flip Assembly as described in first caution note of Section “8.7 Radio Reassembly” on page 8-17.

2. Carefully insert the Flip Flex (2) into the hinge compartment of the Flip Sub-Assembly (3) as shown in Figure 8–25.Peel off the liner of the adhesive at the new Flip Flex (2) connector area and plug in the Flip Flex to the display module. Press fit for 10 seconds to ensure the adhesive is properly activated.

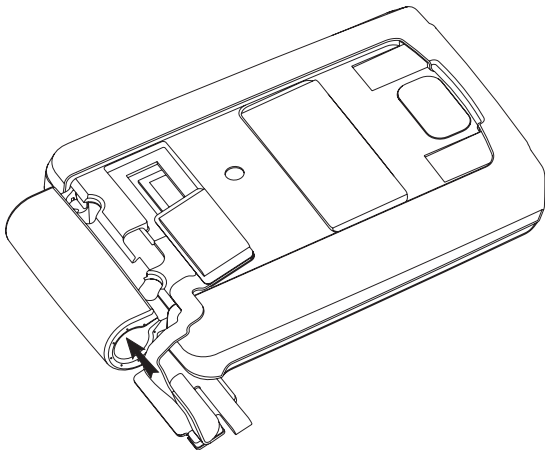


Figure 8–25. Inserting Flip Flex

3. Get a new CID Bezel Kit (1), remove all the liners of the adhesives.
4. Tongue in the CID Bezel Kit (1) into the Flip Sub-Assembly (3), rotating the screw bosses into the receive holes as shown in Figure 8–26. Press fit for 10 seconds to ensure adhesive functionality.

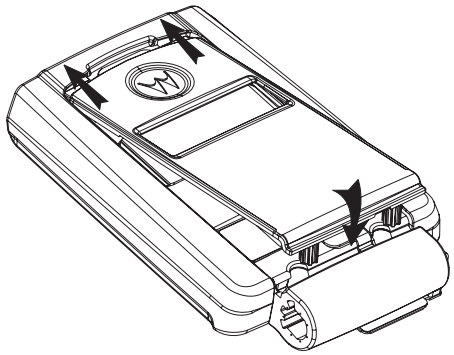


Figure 8–26. Tongue in CID Bezel into Flip Sub-Assembly

5. With the CID Bezel Kit (1) facing down, assemble the 2 screws near the hinge compartment with a Torx T6 bit at 1.5 ± 0.2 in-lbf.
6. Prepare the Flip Inner Housing label surface as described in the first caution note of Section “8.7 Radio Reassembly” on page 8-17. Adhere a new Flip Inner Label (6) to the Flip Sub-Assembly (3), covering the screws.
7. Push the hinge into the opening of the Flip Assembly (A) until it snaps in place.

8.7.2 Reassemble the Front Housing Assembly

To reassemble the Front Housing Assembly (B):

1. Carefully insert each tab of the Flip Stopper Pad (7) into the corresponding openings of the Front Housing. Verify that the stopper is fully seated.

2. While holding the Flip Assembly (A), feed the Flip Flex (2) through the top opening of the Front Housing.
3. With the flip in the open position, assemble the Flip Assembly as follows:

> Caution
>
> Be careful not to pull or pinch the Flip Flex during the assembling process.

   a. Guide the Flip Assembly onto the left knuckle of the Front Housing. Ensure the flip flex is fully inserted in the opening hole of the left knuckle.
   b. Gently open a gap on the right knuckle of the Front Housing while simultaneously pushing the Flip Assembly to engage the Hinge. Simultaneously press on the side of both knuckles and rotate the flip to ensure the hinge is fully inserted into the front housing slot.
4. Peel off the liner of the Flip Flex as shown in Figure 8–27. Rotate the flex into position between the Front Housing alignment tabs. Press fit for 10 seconds to ensure the adhesive is properly activated.

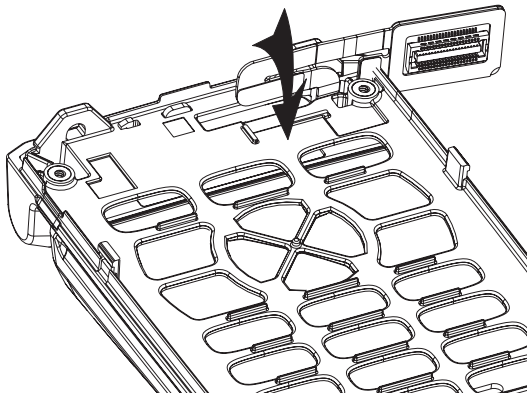


Figure 8–27. Adhere Flip Flex into Front Housing

5. Insert the Microphone Boot (8*) into the Front Housing. Gently push the Microphone into the Microphone Boot. Verify that the Microphone is fully seated.
6. Assemble the Flip Bumper Pad (11) by inserting and fully depressing the tabs into the openings of the Front Housing located in the region between the Keypad and the Speaker Flex compartment.

NOTE: Be careful not to stress the board when plugging the Speaker Flex Connector to the UCM board (10).

7. Assemble the Main Keypad (12) to the Front Housing. Plug in the Speaker Flex Connector to the UCM board (10) with the board position as shown in Figure 8–28**.** Rotate the UCM board (10) into the front housing between the screw bosses and alignment tab.

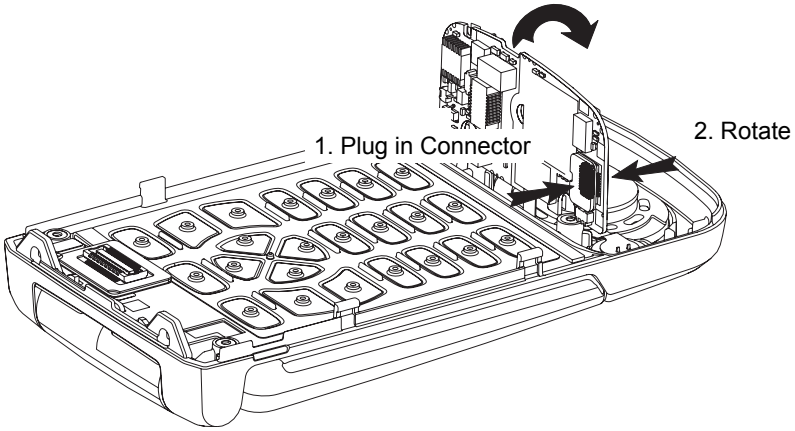


Figure 8–28. Reassemble UCM Board

NOTE: If the Main Keypad Flex and Keypad Backer Sub-Assembly (15) were replaced, skip step 8 and step 9.

8. Remove the liner of the Keypad Backer Inner Jumper Flex (17). Prepare the Keypad Backer Sub-Assembly (15) surface as discussed in the first caution note of Section “8.7 Radio Reassembly” on page 8-17. Plug in the connector of the Keypad Backer Inner Jumper Flex (17) to the Main Keypad flex male connector from the back of Keypad Backer Sub-Assembly**.** Ensure the flex is fully seated by rubbing over the entire area.
9. Attach the Audio Jack Pad (16) and the Secure Pad (14) to the Keypad Backer Sub-Assembly (15).

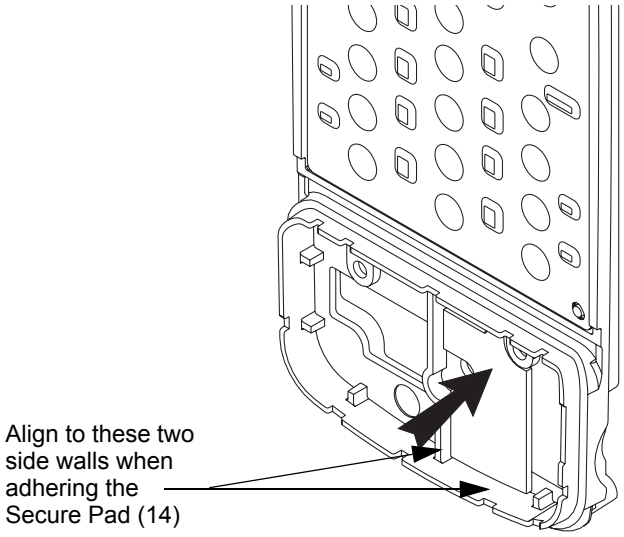


Figure 8–29. Attach Secure Pad to Keypad Backer Sub-Assembly

10. Prepare the surface of the Keypad Backer Sub-Assembly (15) as discussed in the first caution note of Section “8.7 Radio Reassembly” on page 8-17. Remove the 2 liners from the connector area of the Flip Flex (2). While holding the Front Housing Assembly (B) in one hand and the Keypad Backer Assembly in the other as shown in Figure 8–30, plug the connector of the Flip Flex to the Keypad Backer Sub-Assembly. Press fit the whole flex surface especially the perimeter for 10 seconds.

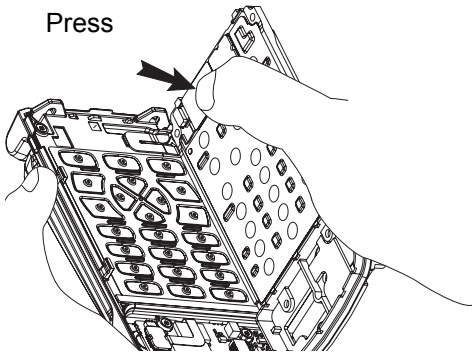


Figure 8–30. Reassemble Flip Flex

NOTE: Prior to reassembling the Speaker Compartment and Main Seals, inspect the seals and sealing surfaces for damage (nicks, cuts, etc.) or dirt.

11. Assemble the Speaker Compartment Seal (13) to the Keypad Backer Sub-Assembly (15). Ensure the seal alignment tabs are properly located and fully seated.
12. With the Flip-Front Housing Assembly (A+B) on a flat surface, tongue in and rotate the Keypad Backer Sub-Assembly assembly into the Front Housing.

NOTE: Be careful when assembling (e.g. DO NOT touch the seal) so that the Speaker Compartment Seal does not drop off from the Keypad Backer Sub-Assembly (15) resulting in a pinched or improperly assembled seal leakage.

13. With the flip housing of the radio facing down, assemble all 4 screws with a Torx T6 bit torque driver at 3.1 in-lbf in the below sequence.

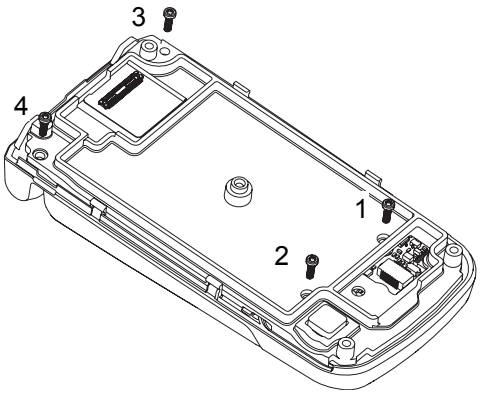


Figure 8–31. Assemble T6 screws to Front Housing

14. Align and Assemble the Main Seal (19) to the Keypad Backer Sub-Assembly (15).

8.7.3 Reassemble the Chassis Assembly

To reassemble the chassis assembly (C):

1. To replace the Top and Side Control Flex, prepare the surface as described in the first caution note of Section “8.7 Radio Reassembly” on page 8-17. Peel off the liner and adhere the flex to the Chassis Assembly (C) by locating it to the top locator pin. Bend the flex 90° and align it to the side control locator features on the Chassis as shown in Figure 8–32. Press fit for 10 seconds.

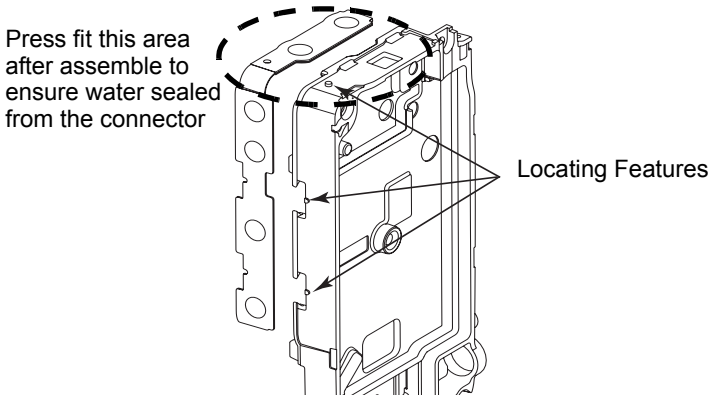


Figure 8–32. Assemble T6 screws to Front Housing

2. Align the Battery Ground Redundant Contact (44) to the Main Chassis (39) and tighten the Battery Connector Screw (45) to hold the connector in place with a Torx T3 bit torque driver at 1.1 in-lbf.
3. Insert tab and rotate to assemble the Antenna Bushing Assembly (42) to the top of the Main Chassis (39). With a Torx T6 bit torque driver at 2.1 in-lbf, tighten the Antenna Bushing Screw (43) on the Antenna Bushing Assembly to secure it in place.
4. Prepare surface as discussed in the first caution note of Section “8.7 Radio Reassembly” on page 8-17. Adhere the CE connector Adhesive (37) to the Main Chassis (39) bottom compartment, remove the liner and adhere the CE board to the casting. Press fit for 10 seconds to ensure the adhesive is properly activated. Pre-assemble the CE Spacer (35) to the CE Retainer (34) with the 2 protrusion on the CE Spacer facing the CE Retainer as shown in Figure 8–33, then carefully insert the bottom hook to mate with the chassis. Next, push the retainer down on the Main Chassis (39) to complete the assembly as shown in Figure 8–34.

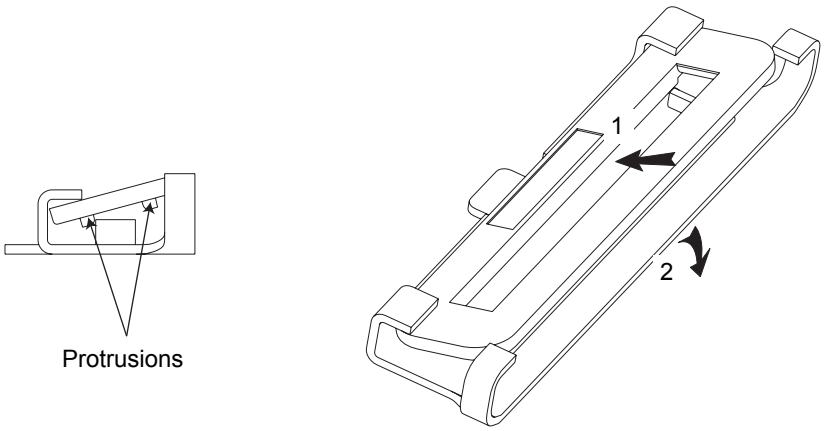


Figure 8–33. Inserting Spacer to CE Retainer

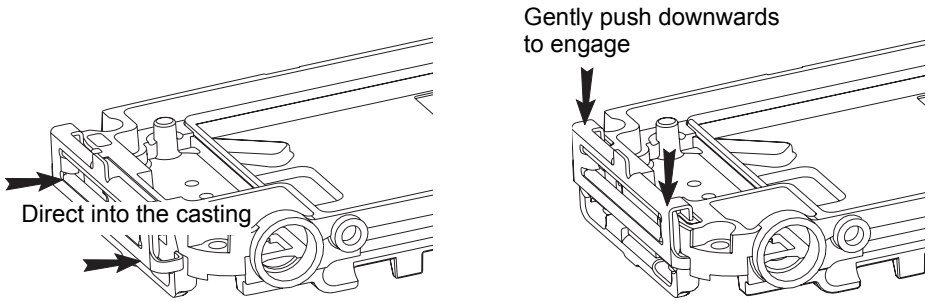


Figure 8–34. Reassemble CE Retainer and Spacer

5. Prepare the Audio Jack Adhesive (27) surfaces as described in the first caution note of Section “8.7 Radio Reassembly” on page 8-17. Place the Audio Jack Seal into the audio jack compartment. Press fit with the black stick for 10 seconds. Assemble the Audio Jack Alignment Sleeve (25) to the Audio Jack Board. Assemble the Audio Jack sub-assemble to the Chassis (C) by resting the Alignment Sleeve fingers on the lip of the Chassis and rotating the sub-assembly into place as shown in Figure 8–35. Press fit for 10 seconds to ensure the adhesive is properly activated.

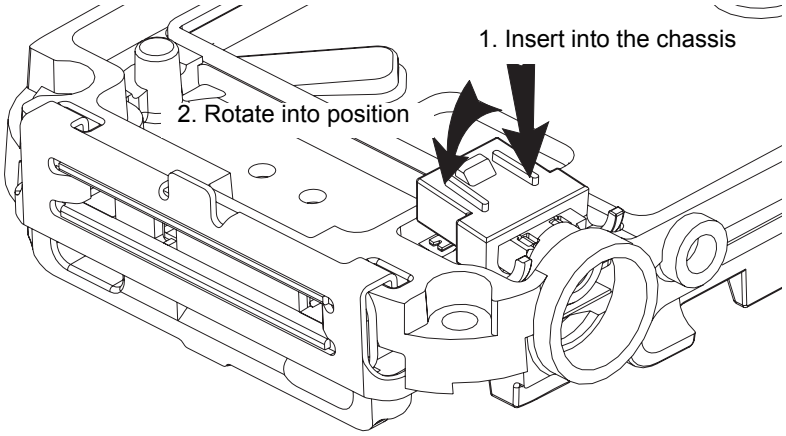


Figure 8–35. Reassemble Flip Flex

6. Slide the Audio Jack Insulator (38) by using the Audio Jack Insertion Tool (refer "8.2 Required Tools and Supplies" on page 8-3 for part number) into the opening of the Chassis until a click sound is heard. Refer Figure 8–36.

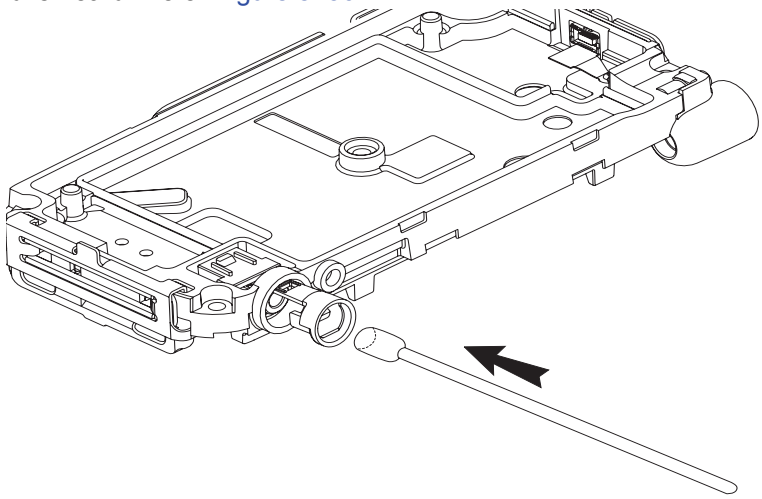


Figure 8–36. Slide Audio Jack Insulator into Chassis

7. Position the CE Connector Dust Cover (21) 90° to the Control Band (20) and gently press the tab into the opening of the Control Band. Rotate both sides of the CE Connector Dust Cover 90° and push the CE Connector Dust Cover upwards into position as shown in Figure 8–37.

> **Caution** Be careful not to bend the Control Band (20) when pressing in the CE Connector Dust Cover (21) as this may damage the Control Band.

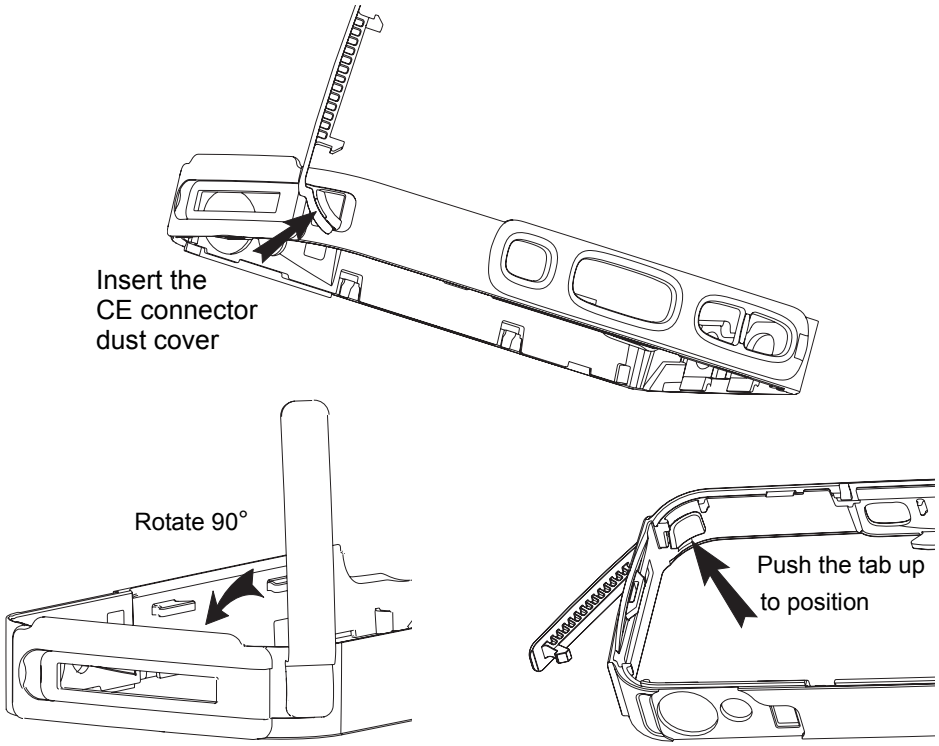


Figure 8–37. Reassemble CE Connector Dust Cover

8. Position the Audio Jack Dust Cover (22) 90° to the Control Band (20). Hook and push the long end of the tab into the opening of the Control Band. Simultaneously rotate both sides of the Audio Jack Dust Cover 90°.

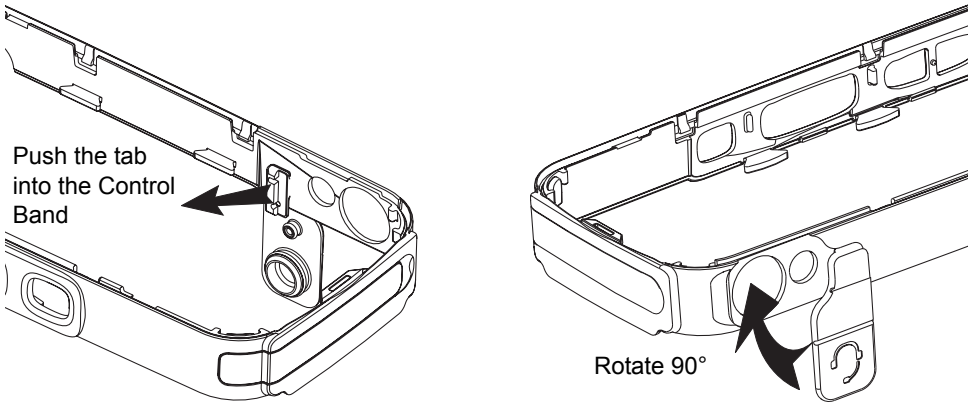


Figure 8–38. Assemble Audio Jack Dust Cover

9. Position the Top and Side Control Assembly Tape across the button openings of the Control Band as shown in Figure 8–39. Assemble the Top Controls Keypad (24) and Side Controls Keypad (23) to the Control Band (20). Make sure the keypads adhere well to the assembly tape so that they do not drop off during reassembly.

> **Caution** Ensure the CE Connector Dust Cover (21) and Audio Jack Dust Cover (22) are in open positions so that they do not interfere with the side Control Band (20) during installation of the control band.

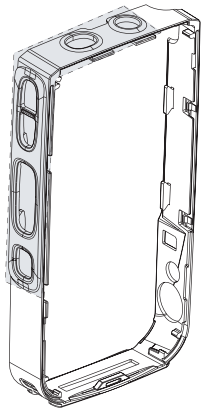


Figure 8–39. Adhere Assembly Aid

NOTE: Be careful not to bend the keypad during the assembly of the Control Band (20). Make sure while rotating the control band towards the chassis, the protrusion on the retainer is inserted properly into the control band bottom sleeve.

10. Position the Control Band (20) over the Chassis (C) as shown in Figure 8–37 and insert the catches on the antenna side of the Control Band into the corresponding Chassis Openings. Pull then rotate the Control Band towards the Main Chassis (39). Slightly pull the **PTT** side of the control band away from the chassis and insert the two catches into the chassis opening. Push the catches up into position. Peel off the top and side control assembly aid.

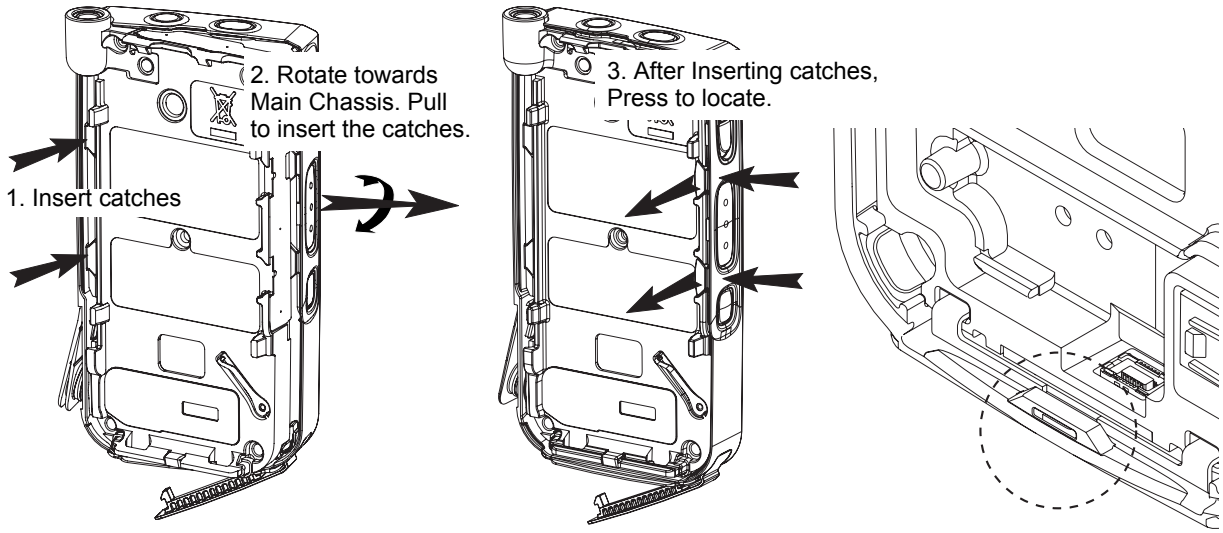


Figure 8–40. Reassemble Control Band

11. Gently press the CE Connector Dust Cover (21) and Audio Jack Dust Cover (22) into the closed position.
12. Prepare the adhesive surfaces as described in the first caution note of Section “8.7 Radio Reassembly” on page 8-17. Insert the CE-UCM Flex through the casting opening beside the audio jack compartment. Plug in the connector of the CE-UCM Connector Flex (28) to the Audio Jack Board (26) by simultaneously pressing on the flex and on the Audio Jack Alignment Sleeve. Adhere new Gore Membrane (47) and Audio Jack PC Label (48) to the back of the Main Chassis (39).
13. Plug in the connector of the CE-UCM Connector Flex to the CE Connector Board.

14. Plug in the connector of the Top Control Inner Jumper Flex (33) to the Side and Top Control Flex (40).

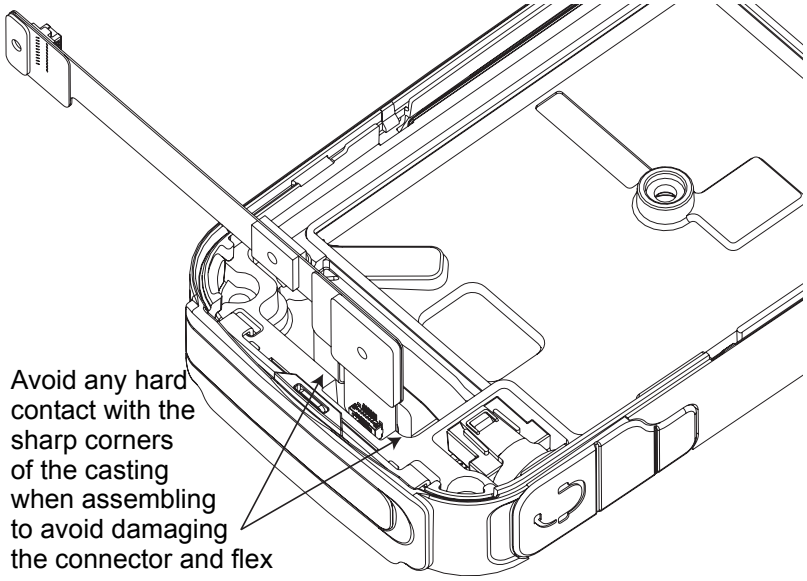


Figure 8–41. Assemble B Plus Seal to B Plus Connector

15. Using a Black Stick, press the Center Screw Seal (32) into position on the Main Chassis (39).
16. Assemble the Thermal Pad (30) and B Plus Seal (31) to the B Plus Connector on the back of the Main Board (29) in the orientation shown.

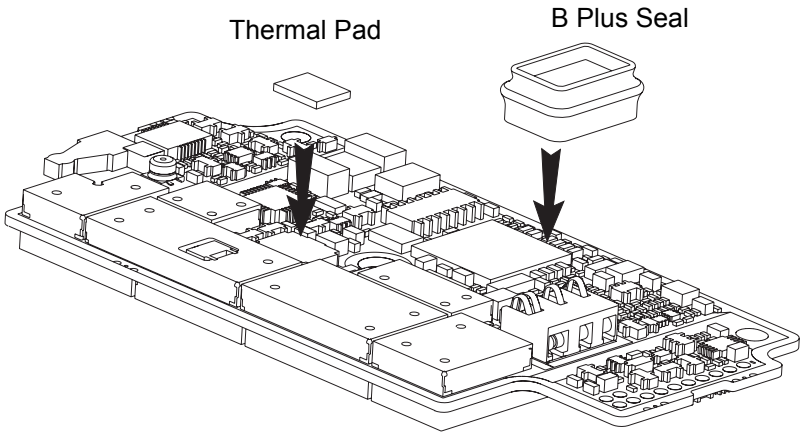


Figure 8–42. Assemble B Plus Seal to B Plus Connector

17. Plug the Top Control Inner Jumper Flex (33) to the Main Board (29).

18. While holding the CE-UCM Flex as shown in Figure 8–43 so as to clear the Main Board, rotate the Main Board (29) towards the chassis and into position by aligning the board to the two chassis alignment pins. Check to make sure the battery B-plus seal is not pinched.

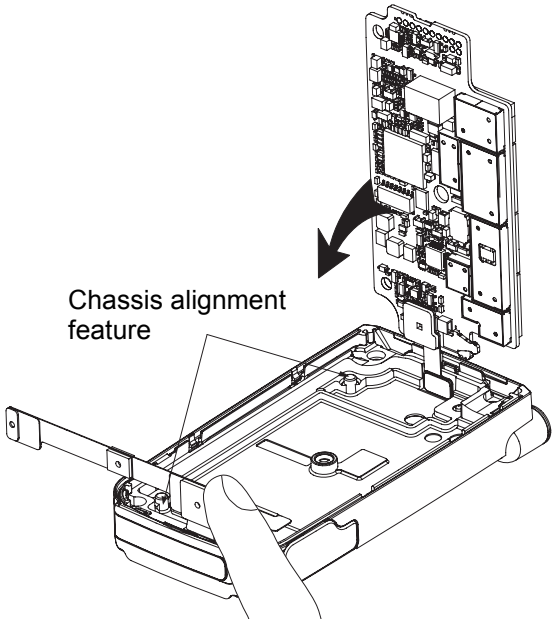


Figure 8–43. Holding CE-UCM Flex

19. Plug the CE-UCM Connector Flex (28) to the Main Board (29).

8.7.4 Assemble the Chassis Assembly to the Flip-Front Housing Assembly

To assemble the chassis sub assembly (C) and Flip-Front Housing Assembly (A+B):

1. Place the Flip-Front Housing Assembly and chassis assembly side by side with the chassis on the right. Plug in the connector of the Keypad Backer Inner Jumper Flex (17) to the Main Board (29) top side. Also plug in the connector on the CE-UCM Connector Flex (28) to the UCM Board (10) located at the bottom of the Flip-Front Housing Assembly as shown in Figure 8–44.

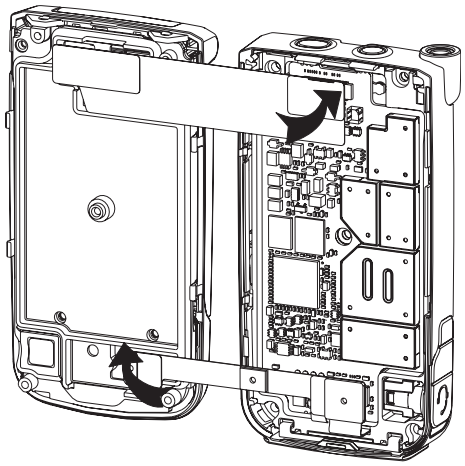


Figure 8–44. Reassemble Flexes

2. Rotate the chassis assembly towards the Flip-Front Housing Assembly. Snap fit both assemblies by pressing the 2 snaps on the **PTT** side and the 2 snaps on the opposite **PTT** side. Ensure there is no bulging between the Front Housing and the Control Band (20) to confirm that the 4 snaps are properly engaged.
3. With the back of the radio facing upward, assemble the 5 screws with a Torx T7 bit at 4.4 in-lbf.

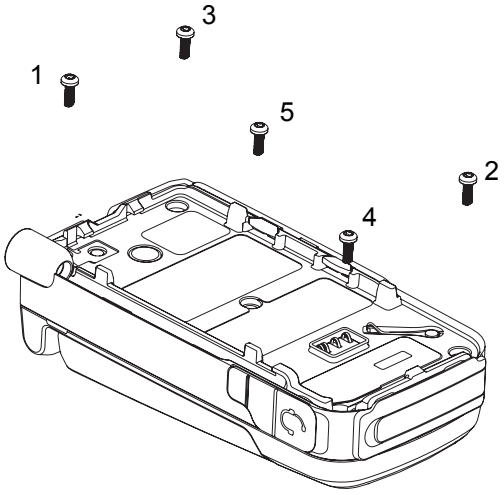


Figure 8–45. Screws Reassemble Sequence

4. Reassemble the antenna to the chassis by turning it clockwise with hand.
5. Tongue in the battery to the bottom of the chassis and press it towards the casting until it clicks.
6. Power on the radio by pressing the **Power Button**.

8.8 Servicing CID Bezel Only

8.8.1 Disassemble CID Bezel

Refer steps 2 to 5 of “8.6.4 Disassemble the Flip Assembly” on page 8-16 to disassemble the CID Bezel Kit (1).

8.8.2 Reassemble CID Bezel

Prepare the Flip Sub-Assembly (3) surface as described in the first caution note of Section “8.7 Radio Reassembly” on page 8-17 then continue reassembling by following steps 3 to 6 of “8.7.1 Reassemble the Flip Assembly” on page 8-18.

Chapter 9 Basic Troubleshooting

This section of the manual contains troubleshooting charts and error codes that will help you to isolate a problem. Level one and two troubleshooting will support only radio alignment, programming, battery replacement, and knob replacement, and circuit board replacement.

Component-level service information can be found in the “ASTRO XTS 4000 Portable Radios Detailed Service Manual,” Motorola publication number 68P71620L01.

9.1 Power-Up Error Codes

When the radio is turned on (power-up), the radio performs self-tests to determine if its basic electronics and software are in working order. Problems detected during these tests are presented as error codes on the radio’s display. For non-display radios, the problem will be presented at power-up by a single, low-frequency tone. The radio should be sent to the depot if cycling power and reprogramming the code plug do not solve the problem. The presence of an error should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors will inhibit user operation; non-fatal errors will not. Use Table 9–1 to aid in understanding particular power-up error code displays.

Table 9–1. Power-Up Error Code Displays

Error Code	Description	Corrective Action
01/02	FLASH ROM Codeplug Checksum Non-Fatal Error	Reprogram the codeplug
01/12	Security Partition Checksum Non-Fatal Error	Send radio to depot
01/20	ABACUS Tune Failure Non-Fatal Error	Turn the radio off, then on
01/22	Tuning Codeplug Checksum Non-Fatal Error	Send radio to depot
01/81	Host ROM Checksum Fatal Error	Send radio to depot
01/82	FLASH ROM Codeplug Checksum Fatal Error	Reprogram the codeplug
01/88	External RAM Fatal Error – **Note:** Not a checksum failure	Send radio to depot
01/90	General Hardware Failure Fatal Error	Turn the radio off, then on
01/92	Security Partition Checksum Fatal Error	Send radio to depot
01/93	FLASHport Authentication Code Failure	Send radio to depot
01/98	Internal RAM Fail Fatal Error	Send radio to depot
01/A2	Tuning Codeplug Checksum Fatal Error	Send radio to depot
02/81	DSP ROM Checksum Fatal Error	Send radio to depot
02/88	DSP RAM Fatal Error – **Note:** Not a checksum failure	Turn the radio off, then on
02/90	General DSP Hardware Failure (DSP startup message not received correctly)	Turn the radio off, then on

Table 9–1. Power-Up Error Code Displays (Continued)

Error Code	Description	Corrective Action
09/10	Secure Hardware Error	Turn the radio off, then on
09/90	Secure Hardware Fatal Error	Turn the radio off, then on
Note: *If the corrective action does not fix the failure, send the radio to the depot.*		

9.2 Operational Error Codes

During radio operation, the radio performs dynamic tests to determine if the radio is working properly. Problems detected during these tests are presented as error codes on the radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use Table 9–2 to aid in understanding particular operational error codes.

Table 9–2. Operational Error Code Displays

Error Code	Description	Corrective Action
FAIL 001	Synthesizer Out-of-Lock	1. Reprogram external codeplug 2. Send radio to depot
FAIL 002	Selected Mode/Zone Codeplug Checksum Error	Reprogram external codeplug

9.3 Receiver Troubleshooting

Table 9–3 lists the possible causes of, and corrections for, receiver problems.

Table 9–3. Receiver Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements at Room Temperature)
Radio Dead; Display Does Not Turn On	1. Dead Battery	Replace with charged battery
	2. Blown Fuse	Send radio to depot
	3. On/Off Switch	
	4. Regulators	
Radio Dead; Display Turns On	Main Board	Send radio to depot
No Receive Audio, or Receiver Does Not Unmute	Programming	1. Does the transmitted signal match the receiver configuration (PL, DPL, etc.)? 2. With the monitor function enabled, can the radio be unmuted?

Table 9–3. Receiver Troubleshooting Chart (Continued)

Symptom	Possible Cause	Correction or Test (Measurements at Room Temperature)
Audio Distorted or Not Loud Enough	Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; realign if off by more than ±1000 Hz
RF Sensitivity Poor	1. Synthesizer Not On Frequency	Check synthesizer frequency by measuring the transmitter frequency; realign if off by more than ±1000 Hz
	2. Antenna Switch/ Connector	Send radio to depot
	3. Receiver Front-End Tuning	Check RF front-end tuning for optimum sensitivity using the tuner
Radio Will Not Turn Off	Main Board	Send radio to depot

9.4 Transmitter Troubleshooting

Table 9–4 lists the possible causes of, and corrections for, transmitter problems.

Table 9–4. Transmitter Troubleshooting Chart

Symptom	Possible Cause	Correction or Test (Measurements Taken at Room Temperature)
No RF Power Out	1. TX Power Level or Frequency	Check TX power level and frequency programming (from tuner)
	2. No Injection To Power Amplifier	Send radio to depot
	3. Antenna Switch/Connector	
No Modulation; Distorted Modulation	1. Programming	Check deviation and compensation settings using the tuner
	2. Main Board	Send radio to depot
Bad Microphone Sensitivity	1. Check Deviation and Compensation	Realign if necessary
	2. Microphone	Send radio to depot
No/Low signaling (PL, DPL, MDC)	1. Programming	Check programming
	2. Main Board	Send radio to depot
Cannot Set Deviation Balance	Main Board	Send radio to depot

9.5 Encryption Troubleshooting

Table 9–5 lists the possible causes of, and corrections for, encryption problems.

Table 9–5. Encryption Troubleshooting Chart

Symptom	Possible Cause	Corrective Action
No "KEYLOAD" on Radio Display When Keyloading Cable is Attached to the Radio Side Connector	1. Defective Keyload Cable	Send radio to depot
	2. Defective Radio	
Keyloader Displays "FAIL"	1. Wrong Keyloader Type	Use correct keyloader type. Refer to Keyloader User Guide for more information
	2. Bad Keyloader	Try another keyloader
	3. Defective Radio	Send radio to depot

Chapter 10 Exploded Views and Parts Lists

This chapter contains exploded views and associated parts lists for the ASTRO XTS 4000 digital portable radios. The following table lists the various exploded views and parts lists for the XTS 4000 radios:

Table 10–1. XTS 4000 Exploded Views and Parts Lists

View	Page
Exploded View and Parts List – Main Assemblies	10-2
Exploded View and Parts List – Flip-Front Housing Assemblies	10-3
Exploded View and Parts List – Chassis Assembly	10-4
Parts List – Service Kit	10-5

10.1 Exploded View and Parts List – Main Assemblies

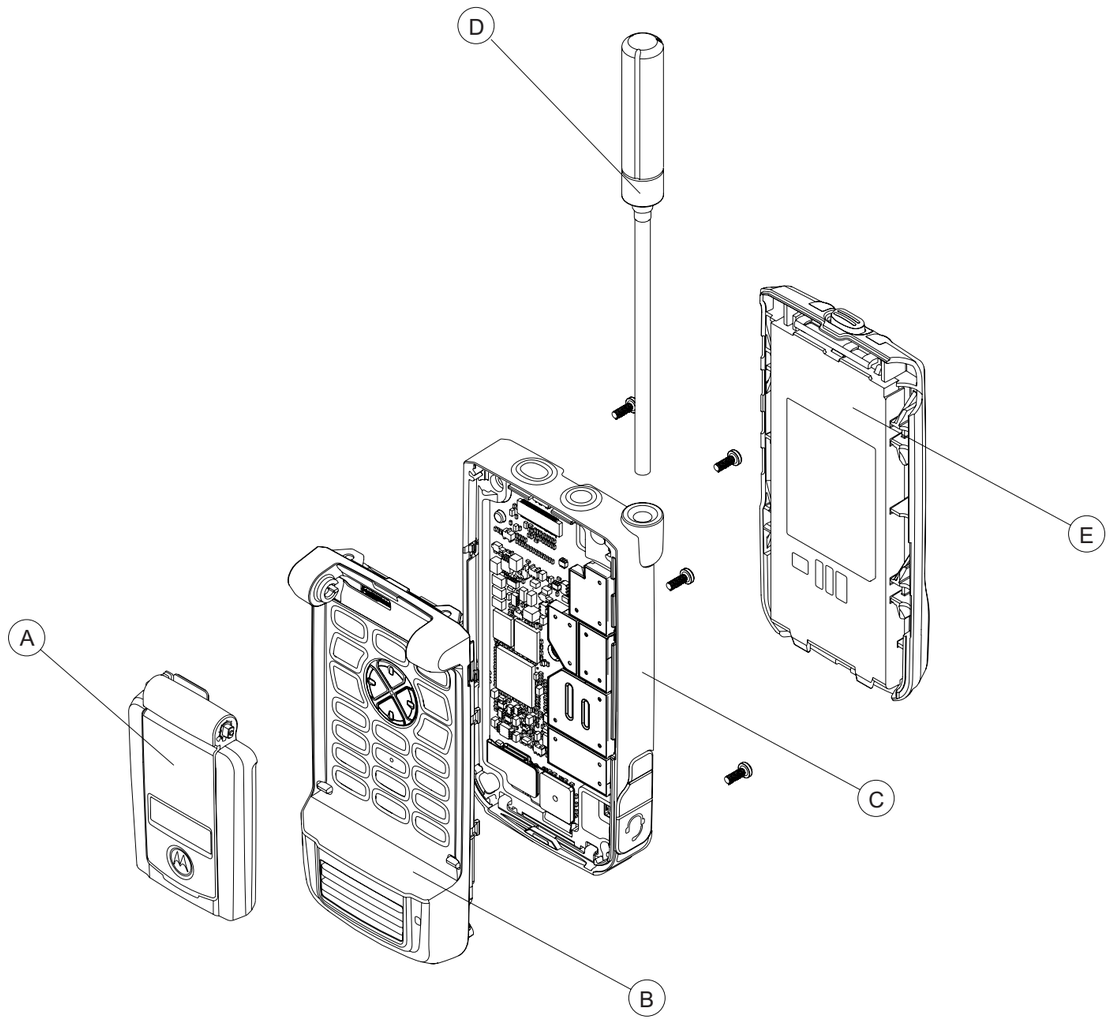


Figure 10–1. Exploded View – Main Assemblies

Table 10-2. Parts List – Main Assemblies

Item No.	Motorola Part Number	Description
A. Flip Assembly		
B. Front Housing Assembly		
C. Chassis Assembly		
D. Antenna Assembly		
	NAD6582_ (8571814L02) *or* NAD6581_ (8571814L04) *or* NAD6583_ (8571814L01) *or* NAE6552_ (8571814L05) *or* NAE6553_ (85012029001)	Antenna 136 – 151 MHz (Yellow coded) Antenna 146 – 162 MHz (Black coded) Antenna 162 – 174 MHz (Blue coded) Antenna 380 – 470 MHz (Red coded) Antenna 380 – 470 MHz
E. Battery Assembly		
	Battery Pack	See Section “A.2 Batteries and Battery Accessories” on page A-1 in “Appendix A: Accessories”

10.2 Exploded View and Parts List – Flip-Front Housing Assemblies

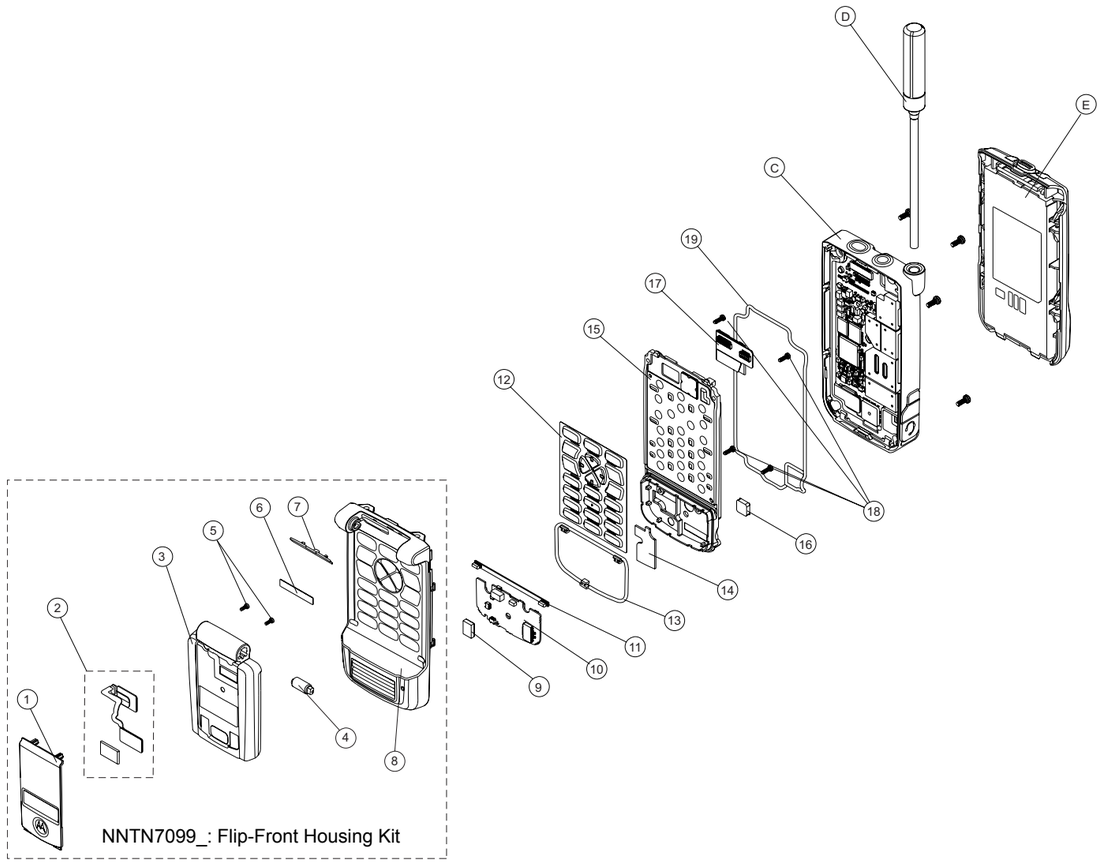


Figure 10–2. Exploded View – Flip – Front Housing Assemblies

Table 10–3. Parts List – Flip-Front Housing Assemblies

Item No.	Motorola Part Number	Description
A. Flip Assembly (NNTN7209_)		
1	1371710L02	Bezel, CID (**Note:** To replace, order NNTN7171_: Field Service Kit – CID Bezel)
2	0104024J62	Flex, Flip (**Note:** To replace, order NNTN7163_: Field Service Kit – Flip Flex)
*	7571858L01	Pad, Conductive Foam (**Note:** Included in NNTN7163_: Field Service Kit – Flip Flex if kit is ordered)
†	1171645L01	Adhesive, Flip Flex - Seal 1 (Backer)
†	1171646L01	Adhesive, Flip Flex - Seal 2 (Flip)
†	1171845L01	Adhesive, Flip Flex Housing
†	1171857L01	Adhesive, Conductive
3	–	Flip Sub-Assembly (**Note:** To replace, order NNTN7209_: Field Service Kit – Flip Assembly)
4	5589594Y02	Hinge, Cam, Silent, 5.8mm Dia. x 5.1mm x 15.6mm
5	0371903L01	Screw, 3MT-P975-0flip
6	3371777L01	Label, Flip Inner (**Note:** Included in kits NNTN7171_ and NNTN7163_ if either kit is ordered)
B. Front Housing Assembly		
7	7571739L01	Pad, Flip Stopper
8	–	Front Housing Sub-Assembly (**Note:** to replace kit, order NNTN7190_: Service Kit – Front Housing and NNTN7189_: Field Service Kit – Adhesive)
*	1471714L01	Boot, Microphone (**Note:** included in NNTN7190_: Service Kit – Front Housing if kit is ordered)
9	7571741L01	Pad, Vibrator (**Note:** included in XTS 4000 UCM Board kit if kit is ordered)
10	Refer Model Chart on page xvi	XTS 4000 UCM Board
11	7571738L01	Pad, Flip Bumper
12	7571175L01	Keypad, Main
13	3271729L01	Seal, Speaker Compartment
14	7571234M01	Pad, Secure (**Note:** Included in NNTN7100_: Assembly, Keypad Backer if kit is ordered)
15	–	Keypad Backer Sub-Assembly (**Note:** To replace, order NNTN7100_: Assembly, Keypad Backer)
16	7571736L01	Pad, Audio Jack (**Note:** Included in NNTN7100_: Assembly, Keypad Backer if kit is ordered)
17	0104024J61	Flex, Keypad Backer Inner Jumper (**Note:** Included in NNTN7100_: Assembly, Keypad Backer if kit is ordered)
†	1171834L01	Adhesive, Internal backer (**Note:** Included in 0104024J61: Flex, Keypad Backer Inner Jumper)
18	0371907L01	Screw, 3MT-P965-0backer
19	3271737L01	Seal, Main
C. Chassis Assembly		
D. Antenna Assembly		
	NAD6582_ (8571814L02) *or* NAD6581_ (8571814L04) *or* NAD6583_ (8571814L01) *or* NAE6552_ (8571814L05) *or* NAE6553_ (85012029001)	Antenna 136 – 151 MHz (Yellow coded) Antenna 146 – 162 MHz (Black coded) Antenna 162 – 174 MHz (Blue coded) Antenna 380 – 470 MHz (Red coded) Antenna 380 – 470 MHz
E. Battery Assembly		
	Battery Pack	See Section “A.2 Batteries and Battery Accessories” on page A-1 in “Appendix A: Accessories”

Note:

* – Items can be ordered individually, but they are inclusive in their respective kit if kit is ordered.

† – Items cannot be ordered individually. They are inclusive in the NNTN7189_: Field Service Kit – Adhesive (refer Table 10–5 "Service Kit Table" on page 10-5).

10.3 Exploded View and Parts List – Chassis Assembly

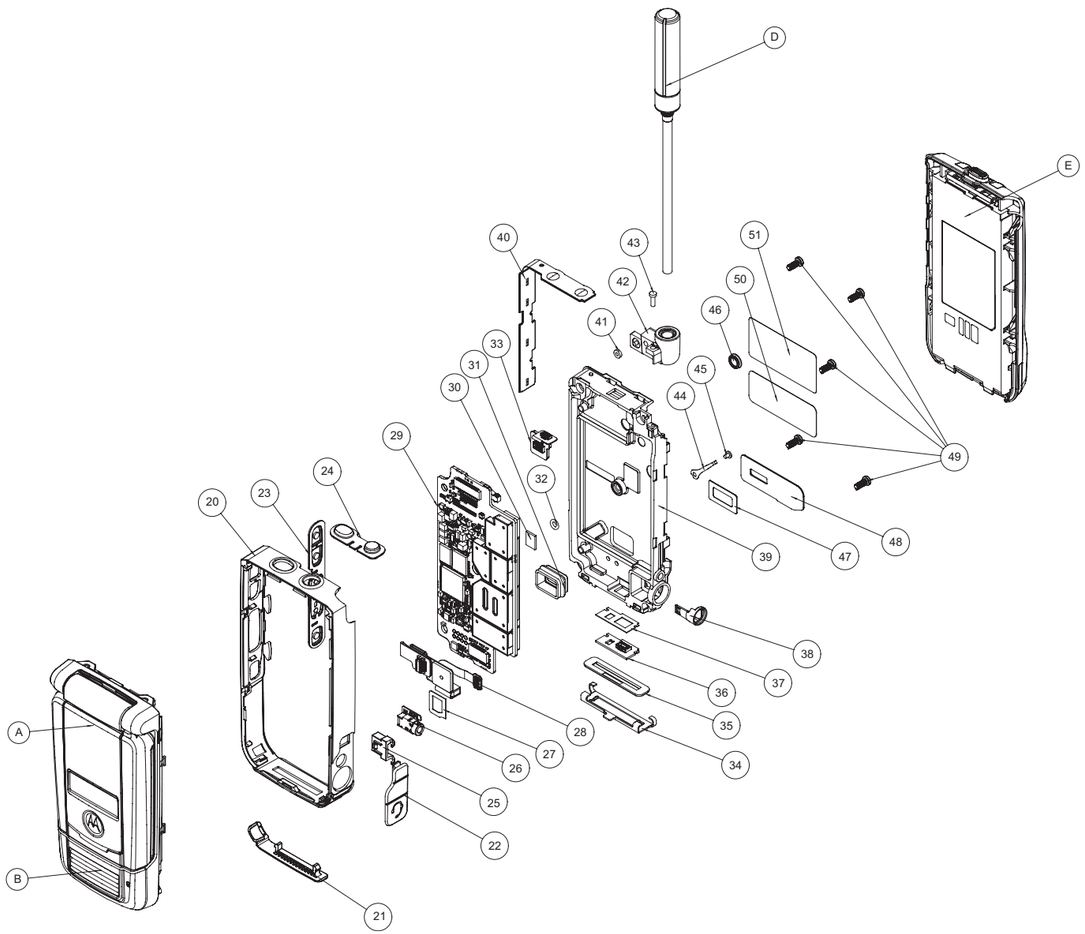


Figure 10–3. Exploded View – Chassis Assembly

Table 10–4. Parts List – Chassis Assembly

Item No.	Motorola Part Number	Description
A. Flip Assembly		
B. Front Housing Assembly		
C. Chassis Assembly		
20	1371131L01	Band, Control
21	3271734L01	Cover, Dust CE Connector
22	3271733L01	Cover, Dust Audio Jack
23	7571176L01	Keypad, Side controls
24	7571179L01	Keypad, Top Controls
25	4371778L01	Audio Jack Alignment Sleeve
26	0104024J66	Board, Audio Jack (**Note:** to replace, order 0104024J66 – Audio Jack Board, 1171635L01– Audio Jack Adhesive, 3271570L01 – Port Seal and 3371776L01 – Audio Jack PC Label)
27	1171635L01	Adhesive, Audio Jack (**Note:** to replace, order 1171635L01 – Audio Jack Adhesive, 3271570L01 – Port Seal and 3371776L01 – Audio Jack PC Label)
28	0104028J17	Flex, CE-UCM Connector
29	Refer Model Chart on page xvi	XTS 4000 VHF Main Board
30	7515719H02	Pad, Thermal and Conductive
31	3271707L01	Seal, B plus
32	3271715L01	Screw Seal
33	0104024J59	Flex, Top Control Inner Jumper
34	4271726L01	Retainer, Bottom CE
35	4371725L01	Spacer, CE
36	0104028J13	Board, CE Connector with Coating (**Note:** To replace, order 0104028J13 and NNTN7189_: Field Service Kit – Adhesive)
37†	1171636L01	Adhesive, CE Connector
38	1471169M01	Audio Jack Insulator
39	2771148L02	Chassis, Main w/ choform
40	0104024J57	Flex, Side & Top Controls
41	3271717L01	Seal, Antenna Bushing
42	4371713L01	Bushing, Antenna Assembly
43	0371907L01	Screw, 3MT-P965-0backer
44	3971718L01	Contact, Battery Ground Redundant
45	0371711L01	Screw, Battery Connector
46	3271732L01	Seal, 5ohm RF Dust Cap
47	3271570L01	Seal, Port (**Note:** to replace, order 3271570L01 – Port Seal and 3371776L01 – Audio Jack PC Label)
48	3371776L01	Audio Jack PC Label (**Note:** to replace, order 3271570L01 – Port Seal and 3371776L01 – Audio Jack PC Label)
49	0371904L01	Screw, 3MT-P964-0chassis
50	3371256L01	Label, Blank (**Note:** Not orderable)
51	3304791J08	Label, FCC (**Note:** Not orderable)
D. Antenna Assembly		
	NAD6582_ (8571814L02)	Antenna 136 – 151 MHz (Yellow coded)
	or NAD6581_ (8571814L04)	Antenna 146 – 162 MHz (Black coded)
	or NAD6583_ (8571814L01)	Antenna 162 – 174 MHz (Blue coded)
	or NAE6552_ (8571814L05)	Antenna 380 – 470 MHz (Red coded)
	or NAE6553_ (85012029001)	Antenna 380 – 470 MHz
E. Battery Assembly		
	Battery Pack	See Section “A.2 Batteries and Battery Accessories” on page A-1 in “Appendix A: Accessories”

Note:

† – Items cannot be ordered individually. They are inclusive in the NNTN7189_: Field Service Kit – Adhesive (refer Table 10–5 "Service Kit Table" on page 10-5).

10.4 Parts List – Service Kit

Table 10–5. Service Kit Table

Item No.	Motorola Part Number	Description
Kit 1:	**NNTN7171_**	**Field Service Kit – CID Bezel**
	1371710L02	Bezel, CID
	3371777L01	Label, Flip Inner
Kit 2:	**NNTN7163_**	**Field Service Kit – Flip Flex**
	1371710L02	Bezel, CID
	0104024J62	Flex, Flip
	3371777L01	Label, Flip Inner
Kit 3:	**NNTN7209_**	**Field Service Kit – Flip Assembly**
	1371710L02	Bezel, CID
	0104024J62	Flex, Flip
	–	Flip Sub-Assembly
	5589594Y02	Hinge, Cam, Silent, (5.8mm Dia. x 5.1mm x 15.6mm)
	0371903L01	Screw, 3MT-P975-0Flip
	3371777L01	Label, Flip Inner
	1171385M01	Lubricant
Kit 4:	**NNTN7190_**	**Service Kit – Front Housing**
	–	Front Housing Sub-Assembly
	1171385M01	Lubricant
Kit 5:	**NNTN7099_**	**Assembly, Flip-Front Housing**
	1371710L02	Bezel, CID
	0104024J62	Flex, Flip
	–	Flip Sub-Assembly
	5589594Y02	Hinge, Cam, Silent, (5.8mm Dia. X 5.1mm X 15.6mm)
	0371903L01	Screw, 3MT-P975-0Flip
	3371777L01	Label, Flip Inner
	7571739L01	Pad, Flip Stopper
	–	Front Housing Sub-Assembly
	1171385M01	Lubricant
Kit 6:	**NNTN7100_**	**Assembly, Keypad Backer**
	7571234M01	Pad, Secure
	–	Keypad Backer Sub-Assembly
	7571736L01	Pad, Audio Jack
	0104024J61	Flex, Keypad Backer Inner Jumper
Kit 7:	**NNTN7189_**	**Field Service Kit – Adhesive**
	1171645L01	Adhesive, Flip Flex – Seal 1 (Backer)
	1171646L01	Adhesive, Flip Flex – Seal 2 (Flip)
	1171845L01	Adhesive, Flip Flex Housing
	1171857L01	Adhesive, Conductive
	1171636L01	Adhesive, CE Connector
	1171834L01	Adhesive, Internal Backer

Notes

Appendix A Accessories

Motorola provides the following approved optional accessories to improve the productivity of the XTS 4000 portable radio.

For a complete list of Motorola-approved antennas, batteries, and other accessories, visit the following web site: http://www.motorolasolutions.com/governmentandenterprise.

A.1 Antennas

NAD6581_	Antenna 146 – 162 MHz, 1.69” (42.8mm), Black Coded
NAD6582_	Antenna 136 – 151 MHz, 1.89” (48.0mm), Yellow Coded
NAD6583_	Antenna 162 – 174 MHz, 1.49” (37.8mm), Blue Coded
NAE6552_	Antenna 380 – 470 MHz, 1.89” (48.0mm), Red Coded
NAE6553_	Antenna 380 – 470 MHz, 5.52” (140.0mm)

A.2 Batteries and Battery Accessories

NNTN6944_	630 mAh Standard Li-Ion Battery
PMNN4083_	1260 mAh Standard Li-Ion Battery

A.3 Carry Accessories

A.3.1 Belt Clips

NNTN6945_	Plastic Belt Clip
NNTN6946_	Leather Belt Clip

A.4 Chargers

EPNN9229_	XTS4000 Charger US 110V AC
EPNN9230_	XTS4000 Charging Cradle
EPNN9231_	XTS4000 Charger 12V Vehicular
WPLN4114_*	Universal Impres Single Unit Charger

NOTE: * Charger requires Battery Adapter (PMLN5429_) to charge XTS 4000 batteries.

A.5 Surveillance Accessories

A.5.1 Headsets and Earpieces

NNTN5006BP*	Headset Earbud with PTT
NNTN5211_†	2-wire Surveillance Kit

NOTE: Recommendation settings via *CPS*:

- Read the radio setting using *CPS*.
- Click **Radio Wide** and select **Tx Audio Control Per Mode**.

* NNTN5006BP – Disable *Digital AGC* and set to +3dB *Digital Fixed Gain*.

† NNTN5211_ – Make sure *Digital AGC* is selected and *Digital Fixed Gain* is 0db. If it is not, Set *Digital Fixed Gain* to 0db and then enable *Digital AGC*.
Radio with NNTN5006BP setting while using this Surveillance accessory, produces degraded sound quality at high talker level.

Appendix B Replacement Parts Ordering

B.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

B.2 Motorola Online

Motorola Online users can access our online catalog at

https://www.motorola.com/businessonline

To register for online access, please call 1-800-422-4210 (for U.S. and Canada Service Centers only). International customers can obtain assistance at https://www.motorola.com/businessonline

B.3 Mail Orders

Mail orders are only accepted by the US Federal Government Markets Division (USFGMD).

Motorola
7031 Columbia Gateway Drive
3rd Floor – Order Processing
Columbia, MD 21046
U.S.A.

B.4 Telephone Orders

Radio Products and Solutions Organization*
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
Monday through Friday (Chicago, U.S.A.)
1-800-422-4210
1-847-538-8023 (United States and Canada)

U.S. Federal Government Markets Division (USFGMD)
1-877-873-4668
8:30 AM to 5:00 PM (Eastern Standard Time)

B.5 Fax Orders

Radio Products and Solutions Organization*
(United States and Canada)
1-800-622-6210
1-847-576-3023 (United States and Canada)

USFGMD
(Federal Government Orders)
1-80526-8641 (For Parts and Equipment Purchase Orders)

B.6 Parts Identification

Radio Products and Solutions Organization*
(United States and Canada)
1-800-422-4210

B.7 Product Customer Service

Radio Products and Solutions Organisation (United States and Canada)
1-800-927-2744

* The Radio Products and Solutions Organization (RPSO) was formerly known as the Radio Products Services Division (RPSD) and/or the Accessories and Aftermarket Division (AAD).

Appendix C Motorola Service Centers

C.1 Servicing Information

If a unit requires further complete testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, please send the radio to a Motorola Service Center as listed below.

C.2 Motorola Service Center

45D Butterfield Trail
El Paso, TX 79906
Tel: 1-800-227-6772

C.3 Motorola Federal Technical Center

4395 Nicole Drive
Lanham, MD 20706
Tel: 1-800-969-6680
Fax: 1-800-784-4133

C.4 Motorola Canadian Technical Logistics Center

Motorola Canada Ltd.
8133 Warden Avenue
Markham, Ontario, L6G 1B3
Tel: 1-800-543-3222
Fax: 1-888-331-9872 or 1-905-948-5970

Notes

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to ASTRO portable and mobile subscriber radio products.

Term	Definition
A/D	*See analog-to-digital conversion.*
Abacus IC	A custom integrated circuit providing a digital receiver intermediate frequency (IF) backend.
ADC	*See analog-to-digital converter.*
ADDAG	*See Analog-to-Digital, Digital-to-Analog and Glue.*
ALC	*See automatic level control.*
analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals. *See also digital.*
Analog-to-Digital, Digital-to-Analog and Glue	An integrated circuit designed to be an interface between the radio's DSP, which is digital, and the analog transmitter and receiver ICs.
analog-to-digital conversion	Conversion of an instantaneous dc voltage level to a corresponding digital value. *See also D/A.*
analog-to-digital converter	A device that converts analog signals into digital data. *See also DAC.*
automatic level control	A circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR.
band	Frequencies allowed for a specific purpose.
BBP	*See baseband interface port.*
baseband interface port	Synchronous serial interface to the transceiver section used to transfer transmit and receive audio data.
BGA	*See ball grid array.*
ball grid array	A type of IC package characterized by solder balls arranged in a grid that are located on the underside of the package.
CE Connector	Radio accessory connector used for communication with a computer for radio programming and radio servicing.
CID	Caller ID display.

Term	Definition
CODEC	*See coder/decoder.*
codeplug	Firmware that contains the unique personality for a system or device. A codeplug is programmable and allows changes to system and unit parameters. *See also firmware.*
coder/decoder	A device that encodes or decodes a signal.
CPS	*See Customer Programming Software.*
Customer Programming Software	Software with a graphical user interface containing the feature set of an ASTRO radio. *See also RSS.*
D/A	*See digital-to-analog conversion.*
DAC	*See digital-to-analog converter.*
default	A pre-defined set of parameters.
digital	Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals. *See also analog.*
digital-to-analog conversion	Conversion of a digital signal to a voltage that is proportional to the input value. *See also A/D.*
digital-to-analog converter	A device that converts digital data into analog signals. *See also ADC.*
Digital Private Line	A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
digital signal processor	A microcontroller specifically designed for performing the mathematics involved in manipulating analog information, such as sound, that has been converted into a digital form. DSP also implies the use of a data compression technique.
digital signal processor code	Object code executed by the Digital Signal Processor in an ASTRO subscriber radio. The DSP is responsible for computation-intensive tasks, such as decoding ASTRO signaling.
DPL	*See Digital Private Line. See also PL.*
DSP	*See digital signal processor.*
DSP code	*See digital signal processor code.*
DTMF	*See dual tone multi-frequency.*

Term	Definition
dual tone multi-frequency	The system used by touch-tone telephones. DTMF assigns a specific frequency, or tone, to each key so that it can easily be identified by a microprocessor.
EEPOT	Electrically Programmable Digital Potentiometer.
EEPROM	*See Electrically Erasable Programmable Read-Only Memory.*
Electrically Erasable Programmable Read-Only Memory	A special type of PROM that can be erased by exposing it to an electrical charge. An EEPROM retains its contents even when the power is turned off.
FCC	Federal Communications Commission.
firmware	Code executed by an embedded processor such as the Host or DSP in a subscriber radio. This type of code is typically resident in non-volatile memory and as such is more difficult to change than code executed from RAM.
FGU	*See frequency generation unit.*
flash	A non-volatile memory device similar to an EEPROM. Flash memory can be erased and reprogrammed in blocks instead of one byte at a time.
FLASHcode	A 13-digit code which uniquely identifies the System Software Package and Software Revenue Options that are enabled in a particular subscriber radio. FLASHcodes are only applicable for radios which are upgradeable through the FLASHport process.
FLASHport	A Motorola term that describes the ability of a radio to change memory. Every FLASHport radio contains a FLASHport EEPROM memory chip that can be software written and rewritten to, again and again.
FMR	*See Florida Manual Revision.*
Florida Manual Revision	A publication that provides supplemental information for its parent publication before it is revised and reissued.
frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
frequency generation unit	This unit generates ultra-stable, low-phase noise master clock and other derived synchronization clocks that are distributed throughout the communication network.
General-Purpose Input/Output	Pins whose function is programmable.
GPIO	*See General-Purpose Input/Output.*

Term	Definition
host code	Object code executed by the host processor in an ASTRO subscriber radio. The host is responsible for control-oriented tasks such as decoding and responding to user inputs.
IC	*See integrated circuit.*
IF	Intermediate Frequency.
IMBE	A sub-band, voice-encoding algorithm used in ASTRO digital voice.
inbound signaling word	Data transmitted on the control channel from a subscriber unit to the central control unit.
integrated circuit	An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.
ISW	*See inbound signaling word.*
key-variable loader	A device used to load encryption keys into a radio.
kHz	*See kilohertz.*
kilohertz	One thousand cycles per second. Used especially as a radio-frequency unit.
KVL	*See key-variable loader.*
LCD	*See liquid-crystal display.*
LED	*See LED.*
light emitting diode	An electronic device that lights up when electricity is passed through it.
LiIon	Lithium-ion.
liquid-crystal display	An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
LO	Local oscillator.
low-speed handshake	15baud digital data sent to the radio during trunked operation while receiving audio.
LSH	*See low-speed handshake.*
Master In Slave Out	SPI data line from a peripheral to the MCU.
Master Out Slave In	SPI data line from the MCU to a peripheral.
MCU	*See microcontroller unit.*
MDC	Motorola Digital Communications.
MDI	MCU/DSP Interface internal to the Patriot IC.

Term	Definition
MHz	*See Megahertz.*
Megahertz	One million cycles per second. Used especially as a radio-frequency unit.
microcontroller unit	Also written as µC. A microprocessor that contains RAM and ROM components, as well as communications and programming components and peripherals.
MISO	*See Master In Slave Out.*
MOSI	*See Master Out Slave In.*
multiplexer	An electronic device that combines several signals for transmission on some shared medium (e.g., a telephone wire).
MUX	*See multiplexer.*
NiCd	Nickel-cadmium.
NiMH	Nickel-metal-hydride.
OMPAC	*See over-molded pad-array carrier.*
open architecture	A controller configuration that utilizes a microprocessor with extended ROM, RAM, and EEPROM.
oscillator	An electronic device that produces alternating electric current and commonly employs tuned circuits and amplifying components.
OSW	*See outbound signaling word.*
OTAR	*See over-the-air rekeying.*
outbound signaling word	Data transmitted on the control channel from the central controller to the subscriber unit.
over-molded pad-array carrier	A Motorola custom IC package, distinguished by the presence of solder balls on the bottom pads.
over-the-air rekeying	Allows the dispatcher to remotely reprogram the encryption keys in the radio.
PA	Power amplifier.
paging	One-way communication that alerts the receiver to retrieve a message.
Patriot IC	A dual-core processor that contains an MCU and a DSP in one IC package.
PC Board	Printed Circuit Board. Also referred to as a PCB.
phase-locked loop	A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PL	*See private-line tone squelch.*

Term	Definition
PLL	*See phase-locked loop.*
private-line tone squelch	A continuous sub-audible tone that is transmitted along with the carrier. *See also DPL.*
Programmable Read-Only Memory	A memory chip on which data can be written only once. Once data has been written onto a PROM, it remains there forever.
PROM	*See Programmable Read-Only Memory.*
PTT	*See Push-to-Talk.*
Push-to-Talk	The switch or button usually located on the left side of the radio which, when pressed, causes the radio to transmit. When the PTT is released, the unit returns to receive operation.
radio frequency	The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
radio frequency power amplifier	Amplifier having one or more active devices to amplify radio signals.
Radio Interface Box	A service aid used to enable communications between a radio and the programming software.
Radio Service Software	DOS-based software containing the feature set of an ASTRO radio. *See also CPS.*
random access memory	A type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes.
RAM	*See random access memory.*
read-only memory	A type of computer memory on which data has been prerecorded. Once data has been written onto a ROM chip, it cannot be removed and can only be read.
real-time clock	A module that keeps track of elapsed time even when a computer is turned off.
receiver	Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.
registers	Short-term data-storage circuits within the microcontroller unit or programmable logic IC.
repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
repeater/talkaround	A conventional radio feature that permits communication through a receive/transmit facility, which re-transmits received signals in order to improve communication range and coverage.

Term	Definition
RESET	Reset line: an input to the microcontroller that restarts execution.
RF	*See radio frequency.*
RF PA	*See radio frequency power amplifier.*
RIB	*See Radio Interface Box.*
ROM	*See read-only memory.*
RPCIC	Regulator/power control IC.
RPT/TA	*See repeater/talkaround.*
RSS	*See Radio Service Software.*
RTC	*See real-time clock.*
RX	Receive.
RX DATA	Recovered digital data line.
SAP	*See Serial Audio CODEC Port.*
SCI IN	Serial Communications Interface Input line.
Serial Audio CODEC Port	SSI to and from the GCAP II IC CODEC used to transfer transmit and receive audio data.
Serial Communication Interface Input Line	A full-duplex (receiver/transmitter) asynchronous serial interface.
SCI IN	*See Serial Communication Interface Input Line.*
Serial Peripheral Interface	How the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
signal	An electrically transmitted electromagnetic wave.
Signal Qualifier mode	An operating mode in which the radio is muted, but still continues to analyze receive data to determine RX signal type.
softpot	*See software potentiometer.*
software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
software potentiometer	A computer-adjustable electronic attenuator.
spectrum	Frequency range within which radiation has specific characteristics.
SPI	*See Serial Peripheral Interface.*

Term	Definition
squelch	Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.
SRAM	*See static RAM.*
SRIB	Smart Radio Interface Box. *See RIB.*
SSI	*See Synchronous Serial Interface.*
Standby mode	An operating mode in which the radio is muted but still continues to monitor data.
static RAM	A type of memory used for volatile, program/data memory that does not need to be refreshed.
Synchronous Serial Interface	DSP interface to peripherals that consists of a clock signal line, a frame synchronization signal line, and a data line.
system central controllers	Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from subscriber units *(See ISW and OSW)*.
system select	The act of selecting the desired operating system with the system-select switch (also, the name given to this switch).
thin small-outline package	A type of dynamic random-access memory (DRAM) package that is commonly used in memory applications.
time-out timer	A timer that limits the length of a transmission.
TOT	*See time-out timer.*
transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TSOP	*See thin small-outline package.*
TX	Transmit.
UART	*See also Universal Asynchronous Receiver Transmitter.*
UHF	Ultra-High Frequency.
Universal Asynchronous Receiver Transmitter	A microchip with programming that controls a computer's interface to its attached serial devices.
Universal Serial Bus	An external bus standard that supports data transfer rates of 12 Mbps.
USB	*See Universal Serial Bus.*
VCO	*See voltage-controlled oscillator.*

Term	Definition
vector sum excited linear predictive coding	A voice-encoding technique used in ASTRO digital voice.
VHF	Very-High Frequency.
VIP	Vehicle Interface Port.
VOCON	*See vocoder/controller.*
vocoder	An electronic device for synthesizing speech by implementing a compression algorithm particular to voice. *See also voice encoder.*
vocoder/controller	A PC board that contains an ASTRO radio's microcontroller, DSP, memory, audio and power functions, and interface support circuitry.
voice encoder	The DSP-based system for digitally processing analog signals, and includes the capabilities of performing voice compression algorithms or voice encoding. *See also vocoder.*
voltage-controlled oscillator	An oscillator in which the frequency of oscillation can be varied by changing a control voltage.

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